

Thermodynamics of Certain Refractory Compounds

THERMODYNAMIC TABLES, BIBLIOGRAPHY, AND PROPERTY FILE

List of Contributors

ANTHROP, D. F., PH.D., Aerojet-General Nucleonics, San Ramon, California

BARRIAULT, R. J., PH.D., (Deceased)

DREIKORN, R. E., PH.D., IBM Components Div., Owego, N. Y.

FEBER, R. C., PH.D., Los Alamos Scientific Lab., Los Alamos, New Mexico

GRIFFEL, M., PH.D., Institute for Defense Analyses, Washington, D. C.

LEIGH, C. H., PH.D., Parametrics Inc., Waltham, Mass.

PANISH, M. B., PH.D., Bell Telephone Laboratories, Murray Hill, New Jersey

SCHICK, H. L., PH.D., Lockheed Missiles & Space Co., Research Laboratories, Palo Alto, California

WARD, C. H., PH.D., Auburn University, Auburn, Alabama

Thermodynamics of Certain Refractory Compounds

HAROLD L. SCHICK

PRINCIPAL CONTRIBUTOR AND EDITOR
IN COLLABORATION WITH THE CONTRIBUTORS

VOLUME II

Thermodynamic Tables, Bibliography, and Property File

SECTIONS VII, VIII, and IX

ACADEMIC PRESS New York and London

PREFACE

Since 1954, the Thermal & Solid State Branch of the Air Force Materials Laboratory has had a continuing interest in delineating materials-environment interactions under extreme thermal environments. This interest has most frequently resulted in the Air Force sponsorship of research programs aimed at the measurement of certain optical, thermophysical and thermodynamic properties of materials, kinetic studies of materials-environment interactions, the development of improved techniques for making these measurements, and the consolidation of literature data in some of these areas. This compilation spawned from these interests.

The magnitude of this effort, as has probably been the case with most works of this type, was underestimated. The work presented here is thus a contribution rather than a completed effort. It is hoped that others will continue in this effort. Thermodynamics has demonstrated itself as an important theoretical tool for predicting the chemical and physical behavior of materials under diverse environmental conditions. Much basic thermodynamic data have been and are now being obtained from many research programs throughout the world. However there has always been a distinct need for a program staffed by highly specialized personnel to evaluate, integrate, extrapolate and otherwise reduce these data to make them available in an interconsistent form directly useful to scientists and engineers for design purposes. The recent establishment of the National Standard Reference Data Program finally indicates the realization that we can no longer afford to be without such a continuing effort to help support and guide our research.

There are certain unique features to this work which have not generally been characteristic of other works of this type or at least not in this degree of detail or in this combination. It is believed that these are desirable features and should be considered in any future work of this type. The user's right to disagree has been profusely aided and abetted since the details of the critical analysis leading to the choice of accepted values are presented. Accuracy estimates are listed for most of the tabulated values. The fact that many of the tables extend to 6000°K and contain tabulation of data at close intervals of temperature is considered a great advantage. The program served as a proving ground for many computer techniques whose impact in the information generation, storage, and retrieval areas are yet to be felt.

The help of Mr. Edmund J. Rolinski and Dr. Emile Rutner of the Thermal & Solid State Branch is gratefully acknowledged as are the unknown visionaries in the higher echelons of the Department of Defense who assigned the special funds for the initiation of this effort. The thanks of the Air Force, the U. S. Government and the scientific community are due to the collaborators and contributors to this compilation. Special gratitude is due to Messrs. Hyman Marcus, Jules I. Wittebort and Leo F. Salzberg whose vision, faith, cooperation, patience and understanding were essential in carrying this work to this point.

Paul W. Dimiduk
Thermal and Solid State Branch
Materials Physics Division
Air Force Materials Laboratory

FOREWORD

This publication is based on a final report (ASD-TR-61-260 Pt. II, 1964) prepared by the Research and Advanced Development Division of the Avco Corporation on Contract AF33(657)-8223 under Project No. 7360, The Chemistry and Physics of Materials: Task No. 736001, Thermodynamics and Heat Transfer. The work was administered under the direction of the Materials Physics Division of the Air Force Materials Laboratory, Research and Technology Division; the RTD monitor on the program was Mr. Paul Dimiduk of the Thermophysics Section. The data reported herein was compiled between 1 June 1962 and 31 December 1963. This work includes a study of the thermodynamics of the borides, carbides, nitrides, and oxides of 31 elements in the temperature range from 0° to 6000°K. The elements are (a) group II A -- beryllium, magnesium, calcium, and strontium; (b) group III B -- scandium, yttrium, and lanthanum, (c) group IV A -- silicon; (d) group IV B -- titanium, zirconium, and hafnium, (e) group V B -- vanadium, niobium, and tantalum; (f) group VI B -- chromium, molybdenum, and tungsten; (g) group VII B -- manganese, technetium, and rhenium; (h) group VIII -- rhodium, osmium, iridium, and platinum; (i) rare earths -- cerium, neodymium, samarium, gadolinium, and dysprosium; and (j) actinides -- uranium and thorium. More than 160 thermodynamic tables, together with comprehensive discussions, have been prepared. The work has been summarized in two volumes.

Volume 1 (published separately, 690 pp, 1966) presents a summary of the techniques used to analyze thermodynamic data and gives the data analyses for refractories considered. Volume 2 (this book) is a compilation of thermodynamic tables generated on this project. It also contains a bibliography and property file. The latter is essentially a subject index for use with the bibliography.

This work has been the result of the efforts of a group of scientists, including Doctors H. L. Schick, D. F. Anthrop, R. J. Barriault, R. E. Dreikorn, R. C. Feber, M. Griffel, C. H. Leigh, M. B. Panish, and C. H. Ward. Project Directors were R. J. Barriault (deceased June 1962), C. H. Leigh (June to December 1962), and H. L. Schick (December 1962 to December 1963). The contributions of different scientists can be identified by reference to the thermodynamic tables of Volume 2. Each of these tables is labeled with the initials of the responsible scientist and the approximate date of the analysis. The corresponding discussion in Volume 1 was also prepared by the same scientist.

His fellow co-workers wish to express their feeling of loss at the untimely passing of Dr. Roland J. Barriault at the beginning of this project in June, 1962. His enthusiasm and leadership were invaluable in a previous contract, AF 33 (616)-7327.

Prof. W. L. Klemperer of Harvard University has acted as consultant on spectroscopic and thermodynamic problems.

Many individuals located throughout the world have been kind enough to provide information to assist this work. An effort has been made to acknowledge such help below. Any omissions are entirely accidental.

L. Akerlind
C. B. Alcock

University of Stockholm
Imperial College of London

FOREWORD

B. Aronsson	University of Uppsala
R. F. Barrow	Oxford University
C. Beckett	National Bureau of Standards
J. Berkowitz	Argonne National Laboratories
J. Berkowitz-Mattuck	Arthur D. Little Company
G. Brauer	University of Freiburg
L. Brewer	University of California
E. R. Cohen	North American Aviation
R. H. Crist	Union Carbide Research Institute
T. Dergazarian	Dow Chemical Company
P. Dimiduk	Research and Technology Division
R. T. Dolloff	National Carbon Company
T. B. Douglas	Heat Division, National Bureau of Standards, Washington, D. C.
J. W. M. DuMond	California Institute of Technology
J. Elliott	Massachusetts Institute of Technology
R. D. Freeman	Oklahoma State University
R. R. Freeman	Chemical Abstracts
M. A. Greenbaum	Rocket Power, Pasadena, California
E. Greenberg	Argonne National Laboratories
C. B. Henderson	Atlantic Research Corporation
G. Herzberg	National Research Council of Canada
D. L. Hildenbrand	Aeronutronics
M. Hoch	University of Cincinnati
R. Honig	Radio Corporation of America
W. N. Hubbard	Argonne National Laboratories
E. Huber	Los Alamos Scientific Laboratory
R. Hultgren	University of California
D. Jackson	Lawrence Radiation Laboratory, Livermore, California
L. Kaufman	Manlabs
K. K. Kelley	Bureau of Mines
R. Kieffer	University of Vienna, Reutte-Tyrol
K. Komarek	New York University
J. E. Kunzler	Bell Telephone Laboratories
T. F. Lyon	General Electric Company
J. L. Margrave	Rice Institute
C. Moore	National Bureau of Standards
J. A. Morrison	National Research Council of Canada
H. Nowotny	University of Vienna
C. D. Pears	Southern Research Institute
B. Pollock	Atomics International
H. Prophet	Dow Chemical Company
E. Rudy	Aerojet-General, Sacramento, California
S. J. Schneider	National Bureau of Standards
A. Sheindlin	Academy of Science, USSR
D. R. Stull and associates	Dow Chemical Company
C. Trulson	Union Carbide, Tarrytown, New York
H. Voess	Atomic Energy Commission
D. Wagman	National Bureau of Standards
E. Westrum	University of Michigan
C. A. Wert	University of Illinois

FOREWORD

Several scientific meetings have provided opportunity for many valuable discussions. They include:

1. A colloquium on diborides held at Arthur D. Little Company under A. D. Little-Manlabs sponsorship in January 1963.
2. An NRC-OCT conference on critical tables of thermodynamic data held at the National Academy of Science on 14-15 March 1963 under the dual chairmanship of Prof. E. Westrum and Dr. G. Waddington.
3. The Stanford Research Institute Symposium on High Temperature Technology at Asilomar, California, in September 1963.
4. A JANAF Thermochemical Panel Meeting in New York City on 5-7 November 1963.

The cooperation of the library staffs at the Massachusetts Institute of Technology, the Cambridge Research Laboratories at Hanscom Field, The New York office of the Atomic Energy Commission, the Division of Technical Information Extension at Oak Ridge, and Avco RAD has been invaluable.

Analyses were aided by the work of the following summer students at Avco RAD: Messrs. J. Hopps (Boston University) and K. Spears (University of Kansas).

Computer and associated programming were aided by the work of Messrs. W. Duffy, E. Levine, J. Paskalides, L. Reid, E. Vancor, and others.

Bibliography preparation, computations, and general assistance with computer facilities were provided by Miss Charlotte Topliffe, and Messrs. D. V. LaRosa, W. L. Perry, W. Wise, G. Costas, G. Hitchcock, and K. Campbell.

Especially valuable throughout this project has been the wide range of help given by Mrs. Patricia Topham, Mrs. Irene A. Hutnick, and Messrs. D. V. LaRosa and L. I. Rose.

The work reported herein was performed at Avco RAD with the help of all levels of management. Dr. M. E. Malin (Vice-President of Research) showed a continuing interest in the progress of this work.

One of us (H. L. Schick) would also like to express appreciation to Mr. R. Capiaux of Lockheed Missiles and Space Company for support in the final stages of publishing this document.

**Vol. 2. Thermodynamic Tables, Bibliography, and Property File
(Sections VII, VIII, and IX)**

TABLE OF CONTENTS

	Page
List of Contributors	ii
Preface	v
Foreword	vii
List of Tables	xiii
Filing Order of Thermodynamic Tables	2-3
Thermodynamic Table Index.	2-13
VII. THERMODYNAMIC TABLES	2-25
VIII. BIBLIOGRAPHY.	2-351
IX. PROPERTY FILE.	2-695

LIST OF TABLES (Continued from Volume 1)

	Page
Table 89 Boron Reference State	2-25
90 Boron Ideal Monatomic Gas	2-27
91 Hafnium Diboride Condensed Phase	2-29
92 Niobium Diboride Condensed Phase	2-31
93 Tantalum Diboride Condensed Phase	2-33
94 Titanium Diboride Condensed Phase	2-35
95 Zirconium Diboride Condensed Phase	2-37
96 Beryllium Reference State	2-39
97 Beryllium Ideal Monatomic Gas	2-41
98 Beryllium Oxide Condensed Phase	2-43
99 Beryllium Oxide Ideal Molecular Gas	2-45
100 Beryllium Carbide Condensed Phase	2-47
101 Dimeric Beryllium Oxide Ideal Molecular Gas	2-49
102 Beryllium Nitride Condensed Phase	2-51
103 Trimeric Beryllium Oxide Ideal Molecular Gas	2-53
104 Tetrameric Beryllium Oxide Ideal Molecular Gas	2-55
105 Pentameric Beryllium Oxide Ideal Molecular Gas	2-57
106 Hexameric Beryllium Oxide Ideal Molecular Gas	2-59
107 Carbon Reference State ..	2-61
108 Carbon Ideal Monatomic Gas	2-63
109 Hafnium Carbide Condensed Phase	2-65

TABLES

		Page
Table 110	Dimolybdenum Carbide Condensed Phase	2-67
111	Niobium Carbide Condensed Phase	2-69
112	Diniobium Carbide Condensed Phase	2-71
113	Silicon Carbide Condensed Phase	2-73
114	Tantalum Carbide Condensed Phase	2-75
115	Ditantalum Carbide Condensed Phase	2-77
116	Thorium Carbide Condensed Phase	2-79
117	Titanium Carbide Condensed Phase	2-81
118	Tungsten Carbide Condensed Phase	2-83
119	Ditungsten Carbide Condensed Phase	2-85
120	Zirconium Carbide Condensed Phase	2-87
121	Diatomic Carbon Ideal Molecular Gas	2-89
122	Trimolybdenum Dicarbide Condensed Phase	2-91
123	Thorium Dicarbide Condensed Phase	2-93
124	Thorium Dicarbide Ideal Molecular Gas	2-95
125	Triatomic Carbon Ideal Molecular Gas	2-97
126	Calcium Reference State	2-99
127	Calcium Ideal Monatomic Gas	2-101
128	Calcium Oxide Condensed Phase	2-103
129	Calcium Oxide Ideal Molecular Gas	2-105
130	Cerium Reference State	2-107
131	Cerium Ideal Monatomic Gas	2-109

TABLES

		Page
Table 132	Cerium Oxide Ideal Molecular Gas	2-111
133	Chromium Reference State	2-113
134	Chromium Ideal Monatomic Gas	2-115
135	Chromium Monoxide Ideal Molecular Gas	2-117
136	Chromium Dioxide Condensed Phase	2-119
137	Chromium Dioxide Ideal Molecular Gas	2-121
138	Chromium Trioxide Condensed Phase	2-123
139	Chromium Trioxide Ideal Molecular Gas	2-125
140	Hafnium Reference State	2-127
141	Hafnium Ideal Monatomic Gas	2-129
142	Hafnium Nitride Condensed Phase	2-131
143	Hafnium Monoxide Ideal Molecular Gas	2-133
144	Hafnium Dioxide Condensed Phase	2-135
145	Hafnium Dioxide Ideal Molecular Gas	2-137
146	Iridium Reference State	2-139
147	Iridium Ideal Monatomic Gas	2-141
148	Iridium Monoxide Ideal Molecular Gas	2-143
149	Magnesium Reference State	2-145
150	Magnesium Ideal Monatomic Gas	2-147
151	Magnesium Oxide Condensed Phase	2-149
152	Magnesium Oxide Ideal Molecular Gas	2-151
153	Magnesium Nitride Condensed Phase	2-153

TABLES

		Page
Table 154	Manganese Reference State	2-155
155	Manganese Ideal Monatomic Gas	2-157
156	Manganese Oxide Ideal Molecular Gas	2-159
157	Molybdenum Reference State	2-161
158	Molybdenum Ideal Monatomic Gas	2-163
159	Molybdenum Monoxide Ideal Molecular Gas	2-165
160	Molybdenum Dioxide Condensed Phase	2-167
161	Molybdenum Dioxide Ideal Molecular Gas	2-169
162	Molybdenum Trioxide Condensed Phase	2-171
163	Molybdenum Trioxide Ideal Molecular Gas	2-173
164	Nitrogen Ideal Monatomic Gas	2-175
165	Niobium Nitride Condensed Phase	2-177
166	Diniobium Nitride Condensed Phase	2-179
167	Tantalum Nitride Condensed Phase	2-181
168	Ditantalum Nitride Condensed Phase	2-183
169	Titanium Nitride Condensed Phase	2-185
170	Zirconium Nitride Condensed Phase	2-187
171	Nitrogen Reference State	2-189
172	Silicon Nitride Condensed Phase	2-191
173	Niobium Reference State	2-193
174	Niobium Ideal Monatomic Gas	2-195
175	Niobium Monoxide Condensed Phase	2-197

TABLES

		Page
Table 176	Niobium Monoxide Ideal Molecular Gas	2-199
177	Niobium Dioxide Condensed Phase	2-201
178	Niobium Dioxide Ideal Molecular Gas	2-203
179	Niobium Pentoxide Condensed Phase	2-205
180	Oxygen Ideal Monatomic Gas	2-207
181	Osmium Monoxide Ideal Molecular Gas	2-209
182	Platinum Monoxide Ideal Molecular Gas	2-211
183	Rhenium Monoxide Ideal Molecular Gas	2-213
184	Rhodium Monoxide Ideal Molecular Gas	2-215
185	Silicon Monoxide Ideal Molecular Gas	2-217
186	Strontium Monoxide Condensed Phase	2-219
187	Strontium Monoxide Ideal Molecular Gas	2-221
188	Tantalum Monoxide Ideal Molecular Gas	2-223
189	Technetium Monoxide Ideal Molecular Gas	2-225
190	Thorium Monoxide Ideal Molecular Gas	2-227
191	Titanium Monoxide Condensed Phase	2-229
192	Titanium Monoxide Ideal Molecular Gas	2-231
193	Uranium Monoxide Ideal Molecular Gas	2-233
194	Tungsten Monoxide Ideal Molecular Gas	2-235
195	Yttrium Monoxide Ideal Molecular Gas	2-237
196	Zirconium Monoxide Ideal Molecular Gas	2-239
197	Oxygen Reference State	2-241

TABLES

		Page
Table 198	Osmium Dioxide Ideal Molecular Gas	2-243
199	Silicon Dioxide Condensed Phase	2-245
200	Silicon Dioxide Ideal Molecular Gas	2-247
201	Tantalum Dioxide Ideal Molecular Gas	2-249
202	Titanium Dioxide Condensed Phase	2-251
203	Titanium Dioxide Ideal Molecular Gas	2-253
204	Uranium Dioxide Condensed Phase	2-255
205	Uranium Dioxide Ideal Molecular Gas	2-257
206	Vanadium Dioxide Ideal Molecular Gas	2-259
207	Tungsten Dioxide Condensed Phase	2-261
208	Tungsten Dioxide Ideal Molecular Gas	2-263
209	Zirconium Dioxide Condensed Phase	2-265
210	Zirconium Dioxide Ideal Molecular Gas	2-267
211	Osmium Trioxide Ideal Molecular Gas	2-269
212	Titanium Sesquioxide Condensed Phase	2-271
213	Tungsten Trioxide Condensed Phase	2-273
214	Tungsten Trioxide Ideal Molecular Gas	2-275
215	Osmium Tetroxide Ideal Molecular Gas	2-277
216	Tantalum Pentoxide Condensed Phase	2-279
217	Trititanium Pentoxide Condensed Phase	2-281
218	Rhenium Heptoxide Condensed Phase	2-283
219	Osmium Reference State	2-285

TABLES

		Page
Table 220	Osmium Ideal Monatomic Gas	2-287
221	Platinum Reference State	2-289
222	Platinum Ideal Monatomic Gas	2-291
223	Rhenium Reference State	2-293
224	Rhenium Ideal Monatomic Gas	2-295
225	Rhodium Reference State	2-297
226	Rhodium Ideal Monatomic Gas	2-299
227	Scandium Reference State	2-301
228	Scandium Ideal Monatomic Gas	2-303
229	Silicon Reference State	2-305
230	Silicon Ideal Monatomic Gas	2-307
231	Strontium Reference State	2-309
232	Strontium Ideal Monatomic Gas	2-311
233	Tantalum Reference State	2-313
234	Tantalum Ideal Monatomic Gas	2-315
235	Technetium Reference State	2-317
236	Technetium Ideal Monatomic Gas	2-319
237	Thorium Reference State	2-321
238	Thorium Ideal Monatomic Gas	2-323
239	Titanium Reference State	2-325
240	Titanium Ideal Monatomic Gas	2-327
241	Uranium Reference State	2-329

TABLES

		Page
Table 242	Uranium Ideal Monatomic Gas	2-331
243	Vanadium Reference State	2-333
244	Vanadium Ideal Monatomic Gas	2-335
245	Tungsten Reference State	2-337
246	Tungsten Ideal Monatomic Gas	2-339
247	Yttrium Reference State	2-341
248	Yttrium Ideal Monatomic Gas	2-343
249	Zirconium Reference State	2-345
250	Zirconium Ideal Monatomic Gas	2-347

VII. THERMODYNAMIC TABLES

This document (volume 2) is made up of thermodynamic tables compiled during this project. In addition, any tables from an earlier project¹ which have not been revised during the present work are included in this volume. Hence, the present volume is a complete compilation of the latest tables generated on both projects.

For the user who wishes to know only the important source data, a brief summary is provided on the back of each table. This summary has been patterned after that of the JANAF thermochemical tables. The brief summaries on the backs of these tables are necessarily very sketchy and only refer to data actually used in producing the tables. For the user who wishes a complete background of all data considered in the analyses prior to table preparation, it is necessary that the data analyses of volume 1 be consulted.² Data analyses for tables carried over from the previous contract may be found in the earlier work.¹

For many of the tables included herein, uncertainty estimates have been provided. These uncertainty estimates (when included) always physically follow the tables to which they refer. The estimates serve two purposes:

1. They provide rough guides to the accuracy of the data tabulated. However because of the wide range in quality of thermodynamic data reported in the literature, it is often difficult to give a reliable estimate of the uncertainty. In some cases, the present estimates may do injustice to very precise data and similarly in other cases the opposite may occur. However, overall, the present estimates are a rough guide to the quality of the data.
2. For the casual user who may feel that data tabulated to three significant figures have this accuracy, the uncertainty estimates provide a more realistic appraisal of the situation.

The order in which the tables are placed is according to the modified Hill³ indexing system for chemical compounds as used by the JANAF Thermochemical Panel Compilation,⁴ Chemical Abstracts, and the Classification Division of the U. S. Patent Office. In the upper right-hand corner of each table is an alphabetic arrangement of the atomic symbols in the chemical formula. The order of the tables is alphabetic according to this compound symbol except for carbon compounds which include the very large organic category. In carbon compounds, the elemental symbol "C" always comes first, immediately followed by "H" if hydrogen is present. The other elemental symbols in carbon compounds then

follow in their regular order. The numbers of atoms of the elements in the compound play a secondary role in determining the tables' positions. Their influence is subordinate to the order in which the atomic symbols occur in the compound symbol. For example, any compound symbol containing "C₂" would come after all others containing "C," regardless of any other element symbols the compound symbol might contain. Reference state and condensed phase tables have been placed before ideal gas tables.

Solid lines with double entries have been used to designate primary transitions, such as solid-state changes, melting points, and normal boiling points, in reference state and condensed phase tables. Dotted lines have been used in the corresponding places in ideal gas tables to indicate discontinuities in the heats of formation of the gases due to the primary transitions in the reference-state phases. Since primary transitions in condensed phases of compounds are not reflected as discontinuities in heats of formation of the corresponding ideal gases, double entries have not been included at such temperatures in ideal gas tables of compounds. Double entries with no lines have been used in tables of compounds to indicate discontinuities in heats of formation due to transitions in the elements.

Two indexes to the tables of this section follow. The filing order presented in tabular form shows the arrangement of tables exactly as they appear (tables 89 to 250). A second index arranged alphabetically can be used for ease in locating a given table.

REFERENCES FOR SECTION VII

1. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds, ASD TR 61-260, Pt. I, Vol. 1 (May 1962).
2. Schick, H. L. et al, Thermodynamics of Certain Refractory Compounds, ASD TR 61-260. Pt. II Vol. 1 (1964), present work.
3. Hill, E. A., J. Am. Chem. Soc. 22, 478 (1900).
4. Dergazarian, T. E. et al, JANAF Interim Thermochemical Tables, Vols. 1 and 2, Dow Chem. Co., Midland, Mich. (31 December 1960).

THE THERMODYNAMIC TABLES*

Table	Title	Conventional Formula	Filing Order
	Boron		
89	Reference State	B	B
90	Ideal Monatomic Gas	B	B
	Hafnium Diboride		
91	Condensed Phase	HfB ₂	B ₂ Hf
	Niobium Diboride		
92	Condensed Phase	NbB ₂	B ₂ Nb
	Tantalum Diboride		
93	Condensed Phase	TaB ₂	B ₂ Ta
	Titanium Diboride		
94	Condensed Phase	TiB ₂	B ₂ Ti
	Zirconium Diboride		
95	Condensed Phase	ZrB ₂	B ₂ Zr
	Beryllium		
96	Reference State	Be	Be
97	Ideal Monatomic Gas	Be	Be
	Beryllium Oxide		
98	Condensed Phase	BeO	BeO
99	Ideal Molecular Gas	BeO	BeO
	Beryllium Carbide		
100	Condensed Phase	Be ₂ C	Be ₂ C
	Dimeric Beryllium Oxide		
101	Ideal Molecular Gas	Be ₂ O ₂	Be ₂ O ₂
	Beryllium Nitride		
102	Condensed Phase	Be ₃ N ₂	Be ₃ N ₂
	Trimeric Beryllium Oxide		
103	Ideal Molecular Gas	Be ₃ O ₃	Be ₃ O ₃

Table	Title	Conventional Formula	Filing Order
104	Tetrameric Beryllium Oxide Ideal Molecular Gas	Be_4O_4	Be_4O_4
105	Pentameric Beryllium Oxide Ideal Molecular Gas	Be_5O_5	Be_5O_5
106	Hexameric Beryllium Oxide Ideal Molecular Gas	Be_6O_6	Be_6O_6
107	Carbon Reference State	C	C
108	Ideal Monatomic Gas	C	C
109	Hafnium Carbide Condensed Phase	HfC	CHf
110	Dimolybdenum Carbide Condensed Phase	Mo_2C	CMo_2
111	Niobium Carbide Condensed Phase	NbC	CNb
112	Diniobium Carbide Condensed Phase	Nb_2C	CNb_2
113	Silicon Carbide Condensed Phase	SiC	CSi
114	Tantalum Carbide Condensed Phase	TaC	CTa
115	Ditantalum Carbide Condensed Phase	Ta_2C	CTa_2
116	Thorium Carbide Condensed Phase	ThC	CTh
117	Titanium Carbide Condensed Phase	TiC	CTi
118	Tungsten Carbide Condensed Phase	WC	CW

Table	Title	Conventional Formula	Filing Order
119	Ditungsten Carbide Condensed Phase	W_2C	CW_2
120	Zirconium Carbide Condensed Phase	ZrC	CZr
121	Diatomic Carbon Ideal Molecular Gas	C_2	C_2
122	Trimolybdenum Dicarbide Condensed Phase	Mo_3C_2	C_2Mo_3
123	Thorium Dicarbide Condensed Phase	ThC_2	C_2Th
124	Ideal Molecular Gas	ThC_2	C_2Th
125	Triatomic Carbon Ideal Molecular Gas	C_3	C_3
126	Calcium Reference State	Ca	Ca
127	Ideal Monatomic Gas	Ca	Ca
128	Calcium Oxide Condensed Phase	CaO	CaO
129	Ideal Molecular Gas	CaO	CaO
130	Cerium Reference State	Ce	Ce
131	Ideal Monatomic Gas	Ce	Ce
132	Cerium Oxide Ideal Molecular Gas	CeO	CeO
133	Chromium Reference State	Cr	Cr
134	Ideal Monatomic Gas	Cr	Cr
135	Chromium Monoxide Ideal Molecular Gas	CrO	CrO

Table	Title	Conventional Formula	Filing Order
136	Chromium Dioxide Condensed Phase	CrO_2	CrO_2
137	Ideal Molecular Gas	CrO_2	CrO_2
138	Chromium Trioxide Condensed Phase	CrO_3	CrO_3
139	Ideal Molecular Gas	CrO_3	CrO_3
140	Hafnium Reference State	Hf	Hf
141	Ideal Monatomic Gas	Hf	Hf
142	Hafnium Nitride Condensed Phase	HfN	HfN
143	Hafnium Monoxide Ideal Molecular Gas	HfO	HfO
144	Hafnium Dioxide Condensed Phase	HfO_2	HfO_2
145	Ideal Molecular Gas	HfO_2	HfO_2
146	Iridium Reference State	Ir	Ir
147	Ideal Monatomic Gas	Ir	Ir
148	Iridium Monoxide Ideal Molecular Gas	IrO	IrO
149	Magnesium Reference State	Mg	Mg
150	Ideal Monatomic Gas	Mg	Mg
151	Magnesium Oxide Condensed Phase	MgO	MgO
152	Ideal Molecular Gas	MgO	MgO
153	Magnesium Nitride Condensed Phase	Mg_3N_2	Mg_3N_2
154	Manganese Reference State	Mn	Mn
155	Ideal Monatomic Gas	Mn	Mn

Table	Title	Conventional Formula	Filing Order
156	Manganese Oxide Ideal Molecular Gas	MnO	MnO
157	Molybdenum Reference State	Mo	Mo
158	Ideal Monatomic Gas	Mo	Mo
159	Molybdenum Monoxide Ideal Molecular Gas	MoO	MoO
160	Molybdenum Dioxide Condensed Phase	MoO ₂	MoO ₂
161	Ideal Molecular Gas	MoO ₂	MoO ₂
162	Molybdenum Trioxide Condensed Phase	MoO ₃	MoO ₃
163	Ideal Molecular Gas	MoO ₃	MoO ₃
164	Nitrogen Ideal Monatomic Gas	N	N
165	Niobium Nitride Condensed Phase	NbN	NNb
166	Diniobium Nitride Condensed Phase	Nb ₂ N	NNb ₂
167	Tantalum Nitride Condensed Phase	TaN	NTa
168	Ditantalum Nitride Condensed Phase	Ta ₂ N	NTa ₂
169	Titanium Nitride Condensed Phase	TiN	NTi
170	Zirconium Nitride Condensed Phase	ZrN	NZr
171	Nitrogen Reference State	N ₂	N ₂

Table	Title	Conventional Formula	Filing Order
172	Silicon Nitride Condensed Phase	Si_3N_4	N_4Si_3
173	Niobium Reference State	Nb	Nb
174	Ideal Monatomic Gas	Nb	Nb
175	Niobium Monoxide Condensed Phase	NbO	NbO
176	Ideal Molecular Gas	NbO	NbO
177	Niobium Dioxide Condensed Phase	NbO_2	NbO_2
178	Ideal Molecular Gas	NbO_2	NbO_2
179	Niobium Pentoxide Condensed Phase	Nb_2O_5	Nb_2O_5
180	Oxygen Ideal Monatomic Gas	O	O
181	Osmium Monoxide Ideal Molecular Gas	OsO	OOs
182	Platinum Monoxide Ideal Molecular Gas	PtO	OPt
183	Rhenium Monoxide Ideal Molecular Gas	ReO	ORe
184	Rhodium Monoxide Ideal Molecular Gas	RhO	ORh
185	Silicon Monoxide Ideal Molecular Gas	SiO	OSi
186	Strontium Monoxide Condensed Phase	SrO	OSr
187	Ideal Molecular Gas	SrO	OSr
188	Tantalum Monoxide Ideal Molecular Gas	TaO	OTa

Table	Title	Conventional Formula	Filing Order
189	Technetium Monoxide Ideal Molecular Gas	TcO	OTc
190	Thorium Monoxide Ideal Molecular Gas	ThO	OTh
191	Titanium Monoxide Condensed Phase	TiO	OTi
192	Titanium Monoxide Ideal Molecular Gas	TiO	OTi
193	Uranium Monoxide Ideal Molecular Gas	UO	OU
194	Tungsten Monoxide Ideal Molecular Gas	WO	OW
195	Yttrium Monoxide Ideal Molecular Gas	YO	OY
196	Zirconium Monoxide Ideal Molecular Gas	ZrO	OZr
197	Oxygen Reference State	O ₂	O ₂
198	Osmium Dioxide Ideal Molecular Gas	OsO ₂	O ₂ Os
199	Silicon Dioxide Condensed Phase	SiO ₂	O ₂ Si
200	Silicon Dioxide Ideal Molecular Gas	SiO ₂	O ₂ Si
201	Tantalum Dioxide Ideal Molecular Gas	TaO ₂	O ₂ Ta
202	Titanium Dioxide Condensed Phase	TiO ₂	O ₂ Ti
203	Titanium Dioxide Ideal Molecular Gas	TiO ₂	O ₂ Ti
204	Uranium Dioxide Condensed Phase	UO ₂	O ₂ U
205	Uranium Dioxide Ideal Molecular Gas	UO ₂	O ₂ U

Table	Title	Conventional Formula	Filing Order
206	Vanadium Dioxide Ideal Molecular Gas	VO_2	O_2V
207	Tungsten Dioxide Condensed Phase	WO_2	O_2W
208	Ideal Molecular Gas	WO_2	O_2W
209	Zirconium Dioxide Condensed Phase	ZrO_2	O_2Zr
210	Ideal Molecular Gas	ZrO_2	O_2Zr
211	Osmium Trioxide Ideal Molecular Gas	OsO_3	O_3Os
212	Titanium Sesquioxide Condensed Phase	Ti_2O_3	O_3Ti_2
213	Tungsten Trioxide Condensed Phase	WO_3	O_3W
214	Ideal Molecular Gas	WO_3	O_3W
215	Osmium Tetroxide Ideal Molecular Gas	OsO_4	O_4Os
216	Tantalum Pentoxide Condensed Phase	Ta_2O_5	O_5Ta_2
217	Trititanium Pentoxide Condensed Phase	Ti_3O_5	O_5Ti_3
218	Rhenium Heptoxide Condensed Phase	Re_2O_7	O_7Re_2
219	Osmium Reference State	Os	Os
220	Ideal Monatomic Gas	Os	Os
221	Platinum Reference State	Pt	Pt
222	Ideal Monatomic Gas	Pt	Pt

Table	Title	Conventional Formula	Filing Order
223	Rhenium Reference State	Re	Re
224	Ideal Monatomic Gas	Re	Re
225	Rhodium Reference State	Rh	Rh
226	Ideal Monatomic Gas	Rh	Rh
227	Scandium Reference State	Sc	Sc
228	Ideal Monatomic Gas	Sc	Sc
229	Silicon Reference State	Si	Si
230	Ideal Monatomic Gas	Si	Si
231	Strontium Reference State	Sr	Sr
232	Ideal Monatomic Gas	Sr	Sr
233	Tantalum Reference State	Ta	Ta
234	Ideal Monatomic Gas	Ta	Ta
235	Technetium Reference State	Tc	Tc
236	Ideal Monatomic Gas	Tc	Tc
237	Thorium Reference State	Th	Th
238	Ideal Monatomic Gas	Th	Th
239	Titanium Reference State	Ti	Ti
240	Ideal Monatomic Gas	Ti	Ti
241	Uranium Reference State	U	U
242	Ideal Monatomic Gas	U	U
243	Vanadium Reference State	V	V
244	Ideal Monatomic Gas	V	V

Table	Title	Conventional Formula	Filing Order
245	Tungsten Reference State	W	W
246	Ideal Monatomic Gas	W	W
247	Yttrium Reference State	Y	Y
248	Ideal Monatomic Gas	Y	Y
249	Zirconium Reference State	Zr	Zr
250	Ideal Monatomic Gas	Zr	Zr

*At the bottom of the tables are listed the dates on which the tables have been completed and the initials of the scientist who prepared them. The same scientist has been responsible for the corresponding discussions which are given in volume 1 of this report.

Name	Initials
Anthrop, D. F.	DFA
Dreikorn, R. E.	RED
Feber, R. C.	RCF
Griffel, M.	MG
Panish, M. B.	MBP
Schick, H. L.	HLS
Ward, C. H.	CHW

THERMODYNAMIC TABLE INDEX

B

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Beryllium		
Reference State	96	2-39
Ideal Monatomic Gas	97	2-41
Beryllium Carbide		
Condensed Phase	100	2-47
Beryllium Nitride		
Condensed Phase	102	2-51
Beryllium Oxide		
Condensed Phase	98	2-43
Ideal Molecular Gas	99	2-45
Dimeric Beryllium Oxide		
Ideal Molecular Gas	101	2-49
Hexameric Beryllium Oxide		
Ideal Molecular Gas	106	2-59
Pentameric Beryllium Oxide		
Ideal Molecular Gas	105	2-57
Tetrameric Beryllium Oxide		
Ideal Molecular Gas	104	2-55
Trimeric Beryllium Oxide		
Ideal Molecular Gas	103	2-53
Boron		
Reference State	89	2-25
Ideal Monatomic Gas	90	2-27

C

Calcium		
Reference State	126	2-99
Ideal Monatomic Gas	127	2-101

THERMODYNAMIC TABLE INDEX

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Calcium Oxide		
Condensed Phase	128	2-103
Ideal Molecular Gas	129	2-105
Carbon		
Reference State	107	2-61
Ideal Monatomic Gas	108	2-63
Diatomic Carbon		
Ideal Molecular Gas	121	2-89
Triatomic Carbon		
Ideal Molecular Gas	125	2-97
Cerium		
Reference State	130	2-107
Ideal Monatomic Gas	131	2-109
Cerium Oxide		
Ideal Molecular Gas	132	2-111
Chromium		
Reference State	133	2-113
Ideal Monatomic Gas	134	2-115
Chromium Dioxide		
Condensed Phase	136	2-119
Ideal Molecular Gas	137	2-121
Chromium Monoxide		
Ideal Molecular Gas	135	2-117
Chromium Trioxide		
Condensed Phase	138	2-123
Ideal Molecular Gas	139	2-125

D

Diatomic Carbon		
Ideal Molecular Gas	121	2-89

THERMODYNAMIC TABLE INDEX

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Dimeric Beryllium Oxide Ideal Molecular Gas	101	2-49
Dimolybdenum Carbide Condensed Phase	110	2-67
Diniobium Carbide Condensed Phase	112	2-71
Diniobium Nitride Condensed Phase	166	2-179
Ditantalum Carbide Condensed Phase	115	2-77
Ditantalum Nitride Condensed Phase	168	2-183
Ditungsten Carbide Condensed Phase	119	2-85

H

Hafnium		
Reference State	140	2-127
Ideal Monatomic Gas	141	2-129
Hafnium Carbide Condensed Phase	109	2-65
Hafnium Diboride Condensed Phase	91	2-29
Hafnium Dioxide		
Condensed Phase	144	2-135
Ideal Molecular Gas	145	2-137
Hafnium Monoxide		
Ideal Molecular Gas	143	2-133

THERMODYNAMIC TABLE INDEX

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Hafnium Nitride Condensed Phase	142	2-131
Hexameric Beryllium Oxide Ideal Molecular Gas	106	2-59
<u>I</u>		
Iridium Reference State	146	2-139
Ideal Monatomic Gas	147	2-141
Iridium Monoxide Ideal Molecular Gas	148	2-143
<u>M</u>		
Magnesium Reference State	149	2-145
Ideal Monatomic Gas	150	2-147
Magnesium Nitride Condensed Phase	153	2-153
Magnesium Oxide Condensed Phase	151	2-149
Ideal Molecular Gas	152	2-157
Manganese Reference State	154	2-155
Ideal Monatomic Gas	155	2-157
Manganese Oxide Ideal Molecular Gas	156	2-159
Molybdenum Reference State	157	2-161
Ideal Monatomic Gas	158	2-163

THERMODYNAMIC TABLE INDEX

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Molybdenum Dioxide		
Condensed Phase	160	2-167
Ideal Molecular Gas	161	2-169
Molybdenum Monoxide		
Ideal Molecular Gas	159	2-165
Molybdenum Trioxide		
Condensed Phase	162	2-171
Ideal Molecular Gas	163	2-173
Dimolybdenum Carbide		
Condensed Phase	110	2-67
Trimolybdenum Dicarbide		
Condensed Phase	122	2-91
 <u>N</u> 		
Niobium		
Reference State	173	2-193
Ideal Monatomic Gas	174	2-195
Niobium Carbide		
Condensed Phase	111	2-69
Niobium Diboride		
Condensed Phase	92	2-31
Niobium Dioxide		
Condensed Phase	177	2-201
Ideal Molecular Gas	178	2-203
Niobium Monoxide		
Condensed Phase	175	2-197
Ideal Molecular Gas	176	2-199
Niobium Nitride		
Condensed Phase	165	2-177

THERMODYNAMIC TABLE INDEX

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Niobium Pentoxide Condensed Phase	179	2-205
Diniobium Carbide Condensed Phase	112	2-71
Diniobium Nitride Condensed Phase	166	2-179
Nitrogen Reference State	171	2-189
Ideal Monatomic Gas	164	2-175
<u>O</u>		
Osmium Reference State	219	2-285
Ideal Monatomic Gas	220	2-287
Osmium Dioxide Ideal Molecular Gas	198	2-243
Osmium Monoxide Ideal Molecular Gas	181	2-209
Osmium Tetroxide Ideal Molecular Gas	215	2-277
Osmium Trioxide Ideal Molecular Gas	211	2-269
Oxygen Reference State	197	2-241
Ideal Monatomic Gas	180	2-207

THERMODYNAMIC TABLE INDEX

P

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Pentameric Beryllium Oxide Ideal Molecular Gas	105	2-57
Platinum		
Reference State	221	2-289
Ideal Monatomic Gas	222	2-291
Platinum Monoxide		
Ideal Molecular Gas	182	2-211

R

Rhenium		
Reference State	223	2-293
Ideal Monatomic Gas	224	2-295
Rhenium Heptoxide		
Condensed Phase	218	2-283
Rhenium Monoxide		
Ideal Molecular Gas	183	2-213
Rhodium		
Reference State	225	2-297
Ideal Monatomic Gas	226	2-299
Rhodium Monoxide		
Ideal Molecular Gas	184	2-215

S

Scandium		
Reference State	227	2-301
Ideal Monatomic Gas	228	2-303
Silicon		
Reference State	229	2-305
Ideal Monatomic Gas	230	2-307

THERMODYNAMIC TABLE INDEX

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Silicon Carbide		
Condensed Phase	113	2-73
Silicon Dioxide		
Condensed Phase	199	2-245
Ideal Molecular Gas	200	2-247
Silicon Monoxide		
Ideal Molecular Gas	185	2-217
Silicon Nitride		
Condensed Phase	172	2-191
Strontium		
Reference State	231	2-309
Ideal Monatomic Gas	232	2-311
Strontium Monoxide		
Condensed Phase	186	2-219
Ideal Molecular Gas	187	2-221

THERMODYNAMIC TABLE INDEX

T

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Tantalum		
Reference State	233	2-313
Ideal Monatomic Gas	234	2-315
Tantalum Carbide		
Condensed Phase	114	2-75
Tantalum Diboride		
Condensed Phase	93	2-33
Tantalum Dioxide		
Ideal Molecular Gas	201	2-249
Tantalum Monoxide		
Ideal Molecular Gas	188	2-223
Tantalum Nitride		
Condensed Phase	167	2-181
Tantalum Pentoxide		
Condensed Phase	216	2-279
Ditantalum Carbide		
Condensed Phase	115	2-77
Ditantalum Nitride		
Condensed Phase	168	2-183
Technetium		
Reference State	235	2-317
Ideal Monatomic Gas	236	2-319
Technetium Monoxide		
Ideal Molecular Gas	189	2-225
Tetrameric Beryllium Oxide		
Ideal Molecular Gas	104	2-55

T (Cont'd)

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Thorium		
Reference State	237	2-321
Ideal Monatomic Gas	238	2-323
Thorium Carbide		
Condensed Phase	116	2-79
Thorium Dicarbide		
Condensed Phase	123	2-93
Ideal Molecular Gas	124	2-95
Thorium Monoxide		
Ideal Molecular Gas	190	2-227
Titanium		
Reference State	239	2-325
Ideal Monatomic Gas	240	2-327
Titanium Carbide		
Condensed Phase	117	2-81
Titanium Diboride		
Condensed Phase	94	2-35
Titanium Dioxide		
Condensed Phase	202	2-251
Ideal Molecular Gas	203	2-253
Titanium Monoxide		
Condensed Phase	191	2-229
Ideal Molecular Gas	192	2-231
Titanium Nitride		
Condensed Phase	169	2-165
Titanium Sesquioxide		
Condensed Phase	212	2-271
Trititanium Pentoxide		
Condensed Phase	217	2-281
Triatomic Carbon		
Ideal Molecular Gas	125	2-97
Trimeric Beryllium Oxide		
Ideal Molecular Gas	103	2-53

T (Concl'd)

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Trimolybdenum Dicarbide Condensed Phase	122	2-91
Trititanium Pentoxide Condensed Phase	217	2-281
Tungsten Reference State	245	2-337
Ideal Monatomic Gas	246	2-339
Tungsten Carbide Condensed Phase	118	2-83
Tungsten Dioxide Condensed Phase	207	2-261
Ideal Molecular Gas	208	2-263
Tungsten Monoxide Ideal Molecular Gas	194	2-235
Tungsten Trioxide Condensed Phase	213	2-273
Ideal Molecular Gas	214	2-275
Ditungsten Carbide Condensed Phase	119	2-85

U

Uranium Reference State	241	2-329
Ideal Monatomic Gas	242	2-311
Uranium Dioxide Condensed Phase	204	2-255
Ideal Molecular Gas	205	2-257
Uranium Monoxide Ideal Molecular Gas	193	2-233

THERMODYNAMIC TABLE INDEX

V

<u>Alphabetical Listing</u>	<u>Table</u>	<u>Page</u>
Vanadium		
Reference State	243	2-333
Ideal Monatomic Gas	244	2-335
Vanadium Dioxide		
Ideal Molecular Gas	206	2-259

Y

Yttrium		
Reference State	247	2-341
Ideal Monatomic Gas	248	2-343
Yttrium Monoxide		
Ideal Molecular Gas	195	2-237

Z

Zirconium		
Reference State	249	2-345
Ideal Monatomic Gas	250	2-347
Zirconium Carbide		
Condensed Phase	120	2-87
Zirconium Diboride		
Condensed Phase	95	2-37
Zirconium Dioxide		
Condensed Phase	209	2-265
Ideal Molecular Gas	210	2-267
Zirconium Monoxide		
Ideal Molecular Gas	196	2-239
Zirconium Nitride		
Condensed Phase	170	2-187

VII
THERMODYNAMIC TABLES

TABLE 89

BORON

REFERENCE STATE

B

Reference State for Calculating ΔH_f° , ΔF° , and Log K_p Solid B from 0° to 2450°K.
 Liquid B from 2450° to 3970°K, Gaseous B from 3970° to 6000°K

T, °K	C_p	$\frac{\text{cal}}{^\circ\text{K gfw}}$ $\int_0^T C_p dT$	$\frac{\text{cal}}{^\circ\text{K gfw}}$ $\int_0^T (C_p - H_{298})/T dT$	$\frac{\text{Kcal/gfw}}{H_f - H_{298}}$ ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-0.290		
298.15	2.823	1.392	1.392	0.000		
300	2.845	1.409	1.389	0.006		
400	3.841	2.374	1.516	0.343		
500	4.498	3.307	1.783	0.762		
600	4.966	4.170	2.108	1.237		
700	5.333	4.964	2.461	1.752		
800	5.639	5.697	2.820	2.301		
900	5.902	6.377	3.178	2.879		
1000	6.130	7.011	3.530	3.481		
1100	6.329	7.605	3.874	4.104		
1200	6.502	8.163	4.208	4.746		
1300	6.652	8.689	4.532	5.403		
1400	6.783	9.187	4.847	6.075		
1500	6.897	9.659	5.153	6.759		
1600	6.996	10.107	5.448	7.454		
1700	7.083	10.534	5.735	8.158		
1800	7.160	10.941	6.013	8.870		
1900	7.228	11.330	6.282	9.590		
2000	7.288	11.703	6.545	10.316		
2100	7.341	12.059	6.798	11.047		
2200	7.388	12.402	7.045	11.784		
2300	7.430	12.731	7.285	12.525		
2400	7.468	13.048	7.519	13.269		
2450	7.485	13.222	7.654	13.642		
2450	7.500	13.522	7.654	19.277		
2500	7.500	13.673	7.812	19.652		
2600	7.500	13.967	8.120	20.402		
2700	7.500	14.250	8.416	21.152		
2800	7.500	14.523	8.701	21.902		
2900	7.500	14.786	8.975	22.652		
3000	7.500	15.041	9.240	23.402		
3100	7.500	15.287	9.496	24.152		
3200	7.500	15.525	9.743	24.902		
3300	7.500	15.756	9.982	25.652		
3400	7.500	15.979	10.214	26.402		
3500	7.500	16.197	10.439	27.152		
3600	7.500	16.408	10.658	27.902		
3700	7.500	16.614	10.870	28.652		
3800	7.500	16.814	11.077	29.402		
3900	7.500	17.009	11.277	30.152		
3969.96	7.500	19.142	11.415	30.676		
3969.96	4.981	49.511	11.415	151.248		
4000	4.982	49.551	11.702	151.397		
4100	4.985	49.674	12.026	151.896		
4200	4.988	49.794	13.510	152.394		
4300	4.993	49.912	14.356	152.893		
4400	4.997	50.027	15.165	153.393		
4500	5.002	50.139	15.941	153.893		
4600	5.008	50.249	16.685	154.393		
4700	5.015	50.357	17.401	154.894		
4800	5.022	50.463	18.089	155.396		
4900	5.030	50.566	18.750	155.899		
5000	5.038	50.668	19.388	156.402		
5100	5.048	50.768	20.002	156.906		
5200	5.058	50.866	20.595	157.412		
5300	5.069	50.962	21.166	157.918		
5400	5.081	51.057	21.719	158.426		
5500	5.093	51.151	22.254	158.934		
5600	5.107	51.242	22.770	159.444		
5700	5.121	51.333	23.271	159.956		
5800	5.136	51.422	23.755	160.468		
5900	5.152	51.510	24.225	160.983		
6000	5.168	51.597	24.681	161.499		

15 March 1963

HLS

0°K to 2450°K
 2450°K to 3969.96°K
 3969.96°K to 6000°K

Crystal
 Liquid
 Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 133.0 \text{ Kcal gfw}^{-1}$$

$$T_m = 2450^{\circ}\text{K}$$

$$T_b = 3969.96^{\circ}\text{K}$$

C_p° data from Wise et al.¹

$$\Delta H_{f298.15}^{\circ} = 0$$

$$S_{298.15}^{\circ} = 1.392 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$\Delta H_m = 5.635 \text{ Kcal gfw}^{-1}$$

$$\Delta H_v = 120.572 \text{ Kcal gfw}^{-1}$$

Structure

Elemental boron has several crystalline modifications. See earlier report² (p 1-76) for further details.

Heat of Formation

Zero by definition

Heat Capacity and Entropy

Low temperature data from Johnston et al.³ and Wise et al.¹

Melting

Several values discussed in earlier report²

Heat of Sublimation

An average of several determination having scatter of about 8 Kcal. See text for more details.

References

1. Wise, S., J. Margrave and R. L. Altman, J. Phys. Chem. **64**, 915 (1960).
2. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds, Pt. I, Vol. 1, ASD TR-61-260 (May 1962).
3. Johnston, H. L., H. N. Hersh and E. C. Kerr, J. Am. Chem. Soc. **73**, 1112 (1951)

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p°	S_T°	$-(F_T - H_{298}^{\circ})/T$	$H_T - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	± 0.200	± 0.020	± 0.020	± 0.000			
1000	± 0.200	± 0.260	± 0.120	± 0.140			
2000	± 0.200	± 0.400	± 0.230	± 0.340			
2450	± 0.200	± 0.420	± 0.250	± 0.430			
2450	± 1.000	± 0.720	± 0.250				
3000	± 1.000	± 0.920	± 0.350	± 1.160			
3969.96	± 1.000	± 1.200	± 0.520	± 1.710			
				± 2.710			

TABLE 90

BORON

IDEAL MONATOMIC GAS

B

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid B from 0° to 2450°K,
Liquid B from 2450° to 3970°K. Gaseous B from 3970° to 6000°K.

T, °K	C_p cal/°K gfw.	C_p cal/°K gfw.	$(F_T - H_{298})/T$ cal/°K gfw.	$H_T - H_{298}$ Kcal/gfw.	ΔH_f Kcal/gfw.	ΔF_f Kcal/gfw.	$\log K_p$
0	0.000	0.000	INFINITE	-1.511	131.779	131.779	INFINITE
298.15	4.971	36.649	36.649	0.000	133.000	122.489	-89.782
300	4.971	36.680	36.650	0.009	133.003	122.422	-89.180
400	4.970	38.110	36.845	0.506	133.163	118.869	-64.943
500	4.969	39.218	37.212	1.003	133.241	115.286	-50.389
600	4.969	40.124	37.624	1.500	133.263	111.691	-40.681
700	4.969	40.840	38.037	1.997	133.245	108.097	-33.747
800	4.968	41.554	38.436	2.494	133.193	104.508	-28.548
900	4.968	42.139	38.815	2.991	133.117	100.927	-24.507
1000	4.968	42.662	39.175	3.487	133.006	97.355	-21.275
1100	4.968	43.136	39.514	3.984	132.880	93.796	-18.634
1200	4.968	43.568	39.833	4.481	132.735	90.250	-16.435
1300	4.968	43.966	40.136	4.978	132.575	86.715	-14.577
1400	4.968	44.334	40.423	5.475	132.400	83.194	-12.986
1500	4.968	44.677	40.695	5.972	132.213	79.687	-11.609
1600	4.968	44.998	40.955	6.468	132.014	76.189	-10.476
1700	4.968	45.299	41.202	6.965	131.807	72.707	-9.346
1800	4.968	45.583	41.437	7.462	131.592	69.237	-8.406
1900	4.968	45.851	41.667	7.959	131.369	65.778	-7.565
2000	4.968	46.106	41.878	8.446	131.140	62.334	-6.811
2100	4.968	46.347	42.086	8.952	130.905	58.896	-6.129
2200	4.968	46.580	42.285	9.449	130.665	55.472	-5.510
2300	4.968	46.801	42.476	9.946	130.421	52.061	-4.946
2400	4.968	47.012	42.660	10.443	130.174	48.662	-4.431
2450	4.968	47.114	42.750	10.691	130.049	47.015	-4.193
2450	4.968	47.114	42.750	10.691	124.414	47.015	-4.193
2500	4.968	47.215	42.839	10.940	124.288	45.433	-3.971
2600	4.968	47.410	43.011	11.437	124.035	42.284	-3.554
2700	4.968	47.597	43.177	11.933	123.781	39.146	-3.168
2800	4.968	47.778	43.338	12.430	123.528	36.017	-2.811
2900	4.969	47.952	43.494	12.927	123.275	32.895	-2.478
3000	4.969	48.121	43.646	13.424	123.022	29.782	-2.169
3100	4.969	48.284	43.793	13.921	122.769	26.680	-1.880
3200	4.970	48.441	43.935	14.418	122.516	23.586	-1.610
3300	4.970	48.594	44.074	14.915	122.263	20.497	-1.357
3400	4.971	48.743	44.210	15.412	122.010	17.414	-1.119
3500	4.972	48.887	44.341	15.909	121.757	14.343	-0.895
3600	4.973	49.027	44.469	16.406	121.504	11.281	-0.684
3700	4.975	49.163	44.594	16.904	121.252	8.222	-0.485
3800	4.977	49.296	44.716	17.401	120.999	5.172	-0.297
3900	4.979	49.425	44.835	17.899	120.747	2.124	-0.119
3969.96	4.981	49.513	44.916	18.247	120.571	0.000	0.000
3969.96	4.981	49.513	44.916	18.247			
4000	4.982	49.551	44.951	18.397			
4100	4.985	49.674	45.066	18.896			
4200	4.988	49.794	45.176	19.394			
4300	4.991	49.912	45.285	19.893			
4400	4.997	50.027	45.392	20.393			
4500	5.002	50.139	45.496	20.893			
4600	5.008	50.249	45.598	21.393			
4700	5.015	50.357	45.698	21.894			
4800	5.022	50.463	45.797	22.396			
4900	5.030	50.566	45.894	22.899			
5000	5.038	50.668	45.987	23.402			
5100	5.048	50.768	46.080	23.906			
5200	5.058	50.866	46.171	24.412			
5300	5.069	50.962	46.260	24.918			
5400	5.081	51.057	46.348	25.426			
5500	5.093	51.151	46.435	25.934			
5600	5.107	51.242	46.519	26.444			
5700	5.121	51.333	46.603	26.956			
5800	5.136	51.422	46.686	27.468			
5900	5.152	51.510	46.767	27.983			
6000	5.168	51.597	46.847	28.499			

16 March 1963

HLS

$$\Delta H_{f0}^{\circ} = 131.779 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $2P_{\frac{1}{2}}$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.511 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 133.0 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 36.649 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

Data from earlier report.¹

Heat of Formation

An average of several determinations having scatter of about 8 Kcal. See earlier report¹ and volume 1, this report for more details.

Heat Capacity and Entropy

From earlier report.¹

Reference

1. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds, Pt. I, Vol. 1, ASD TR-61-260 (May 1962).

BORON, MONATOMIC (B)

(IDEAL GAS)

gfw = 10.82

SUMMARY OF UNCERTAINTY ESTIMATE

T, °K	C_p	S	$H - H_0$	H_f	ΔH_f	$\Delta H_{f298.15}$	$S_{298.15}$
298.15	± 0.001	± 0.001	± 0.001	± 0.001	± 4.000	± 4.000	± 2.910
1000	± 0.001	± 0.001	± 0.001	± 0.001			
2000	± 0.001	± 0.001	± 0.001	± 0.001			
2450	± 0.001	± 0.001	± 0.001	± 0.001			
2450	± 0.001	± 0.001	± 0.001	± 0.001			
3000	± 0.001	± 0.001	± 0.001	± 0.001			
3969.96	± 0.001	± 0.001	± 0.001	± 0.001			

Reference State for Calculating ΔH_f° , ΔH_f° , and $\log K_f$: Solid Hf from 0° to 2495°K,
Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K,
Solid B from 0° to 2450°K, Liquid B from 2450° to 3970°K,
Gaseous B from 3970° to 6000°K, Solid HfB₂ from 0° to
3523°K, Liquid HfB₂ from 3523° to 6000°K.

T, °K	C_p	ΔH_f°	$\Delta H_{f, H_{2O}}^\circ$	ΔH_f°	$\Delta H_{f, H_{2O}}^\circ$	ΔH_f°	$\log K_f$
0	0.000	0.000	INFINITE	-1.706	-79.691	-79.691	INFINITE
298.15	12.000	11.066	11.066	0.000	-80.000	-79.277	58.109
300	12.080	11.142	11.068	0.022	-80.002	-79.274	57.748
400	14.941	15.065	11.584	1.392	-79.970	-79.035	43.181
500	16.365	18.567	12.638	2.965	-79.937	-78.806	34.444
600	17.224	21.632	13.887	4.647	-79.930	-78.585	28.623
700	17.816	24.334	15.190	6.401	-79.948	-78.358	24.463
800	18.266	26.744	16.487	8.206	-79.999	-78.127	21.342
900	18.633	28.917	17.749	10.051	-80.086	-77.888	18.913
1000	18.949	30.897	18.966	11.931	-80.203	-77.637	16.967
1100	19.231	32.716	20.135	13.840	-80.349	-77.374	15.572
1200	19.490	34.401	21.254	15.776	-80.523	-77.096	14.040
1300	19.734	35.971	22.326	17.737	-80.721	-76.803	12.912
1400	19.965	37.442	23.354	19.722	-80.940	-76.494	11.941
1500	20.188	38.827	24.340	21.730	-81.177	-76.166	11.097
1600	20.404	40.136	25.287	23.760	-81.432	-75.827	10.357
1700	20.616	41.380	26.197	25.811	-81.700	-75.466	9.701
1800	20.823	42.564	27.074	27.883	-81.980	-75.093	9.117
1900	21.027	43.695	27.919	29.975	-82.274	-74.705	8.593
2000	21.228	44.779	28.735	32.088	-82.575	-74.292	8.118
2100	21.424	45.817	29.528	34.219	-82.882	-73.853	7.691
2200	21.616	46.821	30.298	36.374	-83.195	-73.385	7.282
2300	21.802	47.787	31.046	38.546	-83.513	-72.887	6.895
2400	22.017	48.720	31.765	40.738	-83.836	-72.359	6.527
2500	22.114	49.615	32.456	42.941	-84.164	-71.859	6.180
2600	22.214	49.578	33.120	45.150	-84.491	-71.387	5.853
2700	22.201	49.578	33.768	47.368	-84.818	-70.932	5.546
2800	22.172	49.517	34.402	49.590	-85.145	-70.493	5.256
2900	22.132	49.395	35.028	51.828	-85.472	-70.069	4.980
3000	22.082	49.217	35.656	54.096	-85.799	-69.659	4.712
3100	22.022	48.985	36.286	56.396	-86.126	-69.264	4.459
3200	21.952	48.700	36.918	58.730	-86.453	-68.884	4.220
3300	21.872	48.365	37.552	61.098	-86.780	-68.519	3.994
3400	21.782	47.985	38.188	63.500	-87.107	-68.169	3.780
3500	21.682	47.565	38.826	65.936	-87.434	-67.834	3.576
3600	21.572	47.100	39.466	68.406	-87.761	-67.514	3.380
3700	21.452	46.595	40.108	70.910	-88.088	-67.209	3.190
3800	21.322	46.055	40.752	73.448	-88.415	-66.919	2.990
3900	21.182	45.485	41.398	76.020	-88.742	-66.644	2.790
4000	21.032	44.890	42.046	78.626	-89.069	-66.384	2.590
4100	20.872	44.265	42.696	81.266	-89.396	-66.139	2.390
4200	20.702	43.615	43.348	83.940	-89.723	-65.909	2.190
4300	20.522	42.945	43.992	86.648	-90.050	-65.694	1.990
4400	20.332	42.255	44.638	89.390	-90.377	-65.494	1.790
4500	20.132	41.545	45.286	92.166	-90.704	-65.309	1.590
4600	19.922	40.815	45.936	94.976	-91.031	-65.139	1.390
4700	19.702	40.065	46.588	97.820	-91.358	-64.984	1.190
4800	19.472	39.295	47.242	100.696	-91.685	-64.844	0.990
4900	19.232	38.505	47.898	103.604	-92.012	-64.719	0.790
4985.40	19.082	37.695	48.556	106.544	-92.339	-64.609	0.590
4985.40	18.922	36.865	49.216	109.516	-92.666	-64.514	0.390
5000	18.752	36.015	49.878	112.520	-92.993	-64.434	0.190
5100	18.572	35.145	50.542	115.556	-93.320	-64.369	-0.010
5200	18.382	34.255	51.208	118.624	-93.647	-64.319	-0.210
5300	18.182	33.345	51.876	121.724	-93.974	-64.284	-0.410
5400	17.972	32.415	52.546	124.856	-94.301	-64.264	-0.610
5500	17.752	31.465	53.218	128.020	-94.628	-64.259	-0.810
5600	17.522	30.495	53.892	131.216	-94.955	-64.269	-1.010
5700	17.282	29.505	54.568	134.444	-95.282	-64.294	-1.210
5800	17.032	28.495	55.246	137.704	-95.609	-64.334	-1.410
5900	16.772	27.465	55.926	141.000	-95.936	-64.389	-1.610
6000	16.502	26.415	56.608	144.332	-96.263	-64.459	-1.810

15 June 1961

$$\Delta H_{f298.15}^{\circ} = -80.0 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 11.068 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3523^{\circ}\text{K}$$

$$\Delta H_m = 20.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.706 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 17.632 + 1.867 \times 10^{-3} T - 5.501 \times 10^{-5} T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 2813^{\circ}\text{K}$$

Structure

Hexagonal type (isotypic with ZrB₂). Narrow range of homogeneity.

Heat of Formation

Value is based on tensimetric data of Paderno et al,¹ vaporization data of Krupka;² and nitrogen equilibria of Rudy and Benesovsky.³

Heat Capacity and Entropy

Low-temperature data have been estimated. High-temperature data of Mezaki et al⁴ and Pears et al⁵ have been recalculated. Heat-capacity equation has been extrapolated to melting point. Data for liquid are estimated.

Melting and Vaporization

Heat of fusion is estimated.

References

1. Paderno, Y. et al, Tsvetnye Metally 11, 48-50 (1959).
2. Krupka, M., LA-2611 (1962).
3. Rudy, E. and F. Benesovsky, Monatsh. Chem. 92, 427 (1961).
4. Mezaki, R. et al, In: Thermodynamics of Nuclear Materials, Internatl. At. Energy Agency, Vienna (1962).
5. Pears, C. D. et al, ASD TDR 62-765 (January 1963).

TABLE 92

NIOBIUM DIBORIDE

CONDENSED PHASE

B₂Nb

Reference State for Calculating ΔH_f , ΔG_f , and $\log K_p$. Solid Nb from 0° to 2741°K, Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K, Solid B from 0° to 2450°K, Liquid B from 2450° to 3970°K, Gaseous B from 3970° to 6000°K, Solid NbB₂ from 0° to 3273°K, Liquid NbB₂ from 3273° to 6000°K.

T, °K	ΔH_f	ΔG_f	$\Delta H_{f, 298}$	$\Delta G_{f, 298}$	ΔH_f	ΔG_f	$\log K_p$
0	0.000	0.000	INFINITE	INFINITE	-1.630	-41.686	INFINITE
298.15	11.500	8.960	8.960	0.000	-41.900	-41.058	30.095
300	11.557	9.031	8.960	0.021	-41.902	-41.055	29.907
400	13.797	12.695	9.445	1.300	-41.897	-40.771	22.275
500	15.207	15.934	10.425	2.754	-41.890	-40.489	17.697
600	16.291	18.805	11.587	4.331	-41.882	-40.212	14.647
700	17.220	21.388	12.806	6.007	-41.864	-39.934	12.467
800	18.067	23.743	14.028	7.772	-41.835	-39.661	10.834
900	18.866	25.918	15.230	9.619	-41.792	-39.392	9.565
1000	19.635	27.945	16.401	11.544	-41.728	-39.128	8.551
1100	20.385	29.852	17.538	13.546	-41.639	-38.871	7.723
1200	21.122	31.657	18.640	15.621	-41.524	-38.625	7.034
1300	21.550	33.365	19.708	17.755	-41.390	-38.391	6.454
1400	21.979	34.978	20.741	19.931	-41.254	-38.163	5.957
1500	22.407	36.504	21.742	22.150	-41.108	-37.946	5.528
1600	22.835	37.969	22.711	24.412	-40.951	-37.743	5.155
1700	23.263	39.366	23.650	26.717	-40.778	-37.548	4.827
1800	23.692	40.708	24.560	29.065	-40.588	-37.362	4.536
1900	24.120	42.000	25.444	31.456	-40.381	-37.190	4.278
2000	24.548	43.248	26.304	33.889	-40.153	-37.024	4.046
2100	24.976	44.456	27.139	36.365	-39.902	-36.877	3.838
2200	25.405	45.628	27.953	38.884	-39.629	-36.741	3.650
2300	25.833	46.767	28.747	41.446	-39.331	-36.617	3.479
2400	26.261	47.875	29.521	44.051	-39.006	-36.505	3.324
2450	26.475	48.419	29.701	45.369	-38.833	-36.353	3.243
2450	26.475	48.419	29.701	45.369	-50.103	-36.353	3.243
2500	26.689	48.956	30.276	46.699	-49.925	-36.075	3.154
2600	27.118	50.011	31.015	49.389	-49.546	-35.530	2.986
2700	27.546	51.042	31.738	52.122	-49.133	-34.999	2.833
2741	27.722	51.459	32.030	53.255	-48.953	-34.787	2.774
2741	27.722	51.459	32.030	53.255	-55.353	-34.787	2.774
2800	27.974	52.052	32.446	54.898	-55.068	-34.346	2.681
2900	28.403	53.041	33.139	57.717	-54.549	-33.615	2.533
3000	28.831	54.011	33.818	60.579	-53.987	-32.900	2.397
3100	29.259	54.964	34.485	63.483	-53.383	-32.203	2.270
3200	29.687	55.899	35.140	66.430	-52.736	-31.535	2.154
3273	30.000	56.572	35.610	68.609	-52.235	-31.057	2.074
3273	30.000	62.683	35.610	88.609	-32.235	-31.057	2.074
3300	30.000	62.929	35.833	89.419	-32.047	-31.050	2.056
3400	30.000	63.825	36.643	92.419	-31.347	-31.027	1.994
3500	30.000	64.645	37.432	95.419	-30.647	-31.029	1.937
3600	30.000	65.540	38.201	98.419	-29.947	-31.046	1.885
3700	30.000	66.362	38.951	101.419	-29.247	-31.089	1.836
3800	30.000	67.162	39.683	104.419	-28.547	-31.142	1.791
3900	30.000	67.941	40.398	107.419	-27.847	-31.230	1.750
3969.96	30.000	68.474	40.888	109.518	-27.356	-31.288	1.722
3969.96	30.000	68.474	40.888	109.518	-268.500	-31.288	1.722
4000	30.000	68.701	41.026	110.419	-268.137	-29.488	1.611
4100	30.000	69.441	41.778	113.419	-266.935	-23.540	1.255
4200	30.000	70.164	42.446	116.419	-265.731	-17.620	0.917
4300	30.000	70.870	43.098	119.419	-264.529	-11.714	0.595
4400	30.000	71.560	43.733	122.419	-263.326	-5.851	0.291
4500	30.000	72.234	44.336	125.419	-262.129	-0.014	0.001
4600	30.000	72.893	44.916	128.419	-260.929	5.793	-0.275
4700	30.000	73.539	45.577	131.419	-259.731	11.581	-0.539
4800	30.000	74.170	46.166	134.419	-258.535	17.346	-0.790
4900	30.000	74.789	46.744	137.419	-257.341	23.074	-1.029
5000	30.000	75.395	47.311	140.419	-256.147	28.790	-1.258
5031.58	30.000	75.584	47.488	141.366	-255.771	30.520	-1.326
5031.58	30.000	75.584	47.488	141.366	-418.344	30.520	-1.326
5100	30.000	75.989	47.858	143.419	-417.570	36.620	-1.569
5200	30.000	76.572	48.414	146.419	-416.449	45.522	-1.913
5300	30.000	77.143	48.951	149.419	-415.333	54.380	-2.242
5400	30.000	77.704	49.478	152.419	-414.226	63.238	-2.559
5400	30.000	78.254	49.996	155.419	-413.125	72.076	-2.864
5600	30.000	78.794	50.506	158.419	-412.032	80.874	-3.156
5700	30.000	79.326	51.007	161.419	-410.948	89.673	-3.438
5800	30.000	79.848	51.499	164.419	-409.868	98.448	-3.709
5900	30.000	80.360	51.984	167.419	-408.798	107.205	-3.971
6000	30.000	80.864	52.461	170.419	-407.734	115.948	-4.223

15 September 1963

HLS

NIOBIUM DIBORIDE (NbB₂)

(CONDENSED PHASE)

gfw = 114.55

$$\Delta H_{f298.15}^{\circ} = -41.9 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 8.96 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3273^{\circ}\text{K}$$

$$\Delta H_m = 20.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.630 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 13.004 + 6.9491 \times 10^{-3} T - 3.1784 \times 10^{-5} T^2 \quad 298.15^{\circ}\text{K} \leq T \leq 1200^{\circ}\text{K}$$

$$C_p^{\circ} = 15.983 + 0.0042826 T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1200^{\circ}\text{K} \leq T \leq 3273^{\circ}\text{K}$$

$$C_p^{\circ} = 30.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$3773^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

NbB₂ has a hexagonal structure

Heat of Formation

Based on unpublished heat of combustion studies by Huber¹

Heat Capacity and Entropy

Low temperature data was obtained by Westrum² for NbB_{1.975}. A minor correction was made to the stoichiometric composition. Data from 298.15 to 1200°K were analyzed by Shomate method using Tilleux's³ enthalpy values. Data above 1200°K was estimated.

Melting and Vaporization

Melting point was tabulated by Nowotny et al⁴. Heat of melting was estimated

References

1. Huber, E., Jr., Private Communication, April 1, 1963.
2. Westrum E. F., In: Kaufman, L. and E. Clougherty, Investigation of Boride Compounds for Very High Temperature Applications, Man Labs Semi-Annual Report No. 2, Contract AF33(657)-8635 (April 1963); See Also Final Report, Same Contract, RTD-TDR-63-4096, Part I (December 1963).
3. Tilleux, E. W., M. S. Thesis, U. of Wisconsin, January 1963
4. Nowotny, H. et al., Z. Metallkunde 50, 417 (1959).

NIOBIUM DIBORIDE (NbB₂)

(CONDENSED PHASE)

GFW = 114.55

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(H_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔI_f°	Log k_p
298.15	±0.500	±0.100	±0.100	±0.000			
1000	±0.500	±0.705	±0.354	±0.351			
1500	±0.500	±0.908	±0.507	±0.601			
1500	±2.000	±0.908	±0.507	±0.601			
2000	±2.000	±1.483	±0.683	±1.601			
3000	±2.000	±2.294	±1.094	±3.601			
3273	±2.000	±2.468	±1.201	±4.147			
3273	±3.000	±3.996	±1.201	±9.147			
4000	±3.000	±4.598	±1.766	±11.328			
5000	±3.000	±5.267	±2.402	±14.328			
6000	±3.000	±5.814	±2.926	±17.328			

TABLE 93

TANTALUM DIBORIDE

CONDENSED PHASE

B₂Ta

Reference State for Calculating ΔH_f° , ΔF_f° and $\log K_p$: Solid Ta from 0° to 3270°K, Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K, Solid B from 0° to 2450°K, Liquid B from 2450° to 3970°K, Gaseous B from 3970° to 6000°K, Solid TaB₂ from 0° to 3373°K, Liquid TaB₂ from 3373° to 6000°K.

T, °K	C_p	ΔH_f° cal./°K gfw	$-(F_T^\circ - H_{298}^\circ)/T$	ΔH_f° Kcal./gfw	ΔF_f°	$\log K_p$
C	0.000	0.000	INFINITE	-1.665	-49.700	INFINITE
298.15	11.500	10.603	10.603	0.000	-49.374	36.190
300	11.559	10.674	10.603	0.021	-49.371	35.965
400	13.759	14.337	11.088	1.300	-49.158	26.857
500	15.019	17.553	12.066	2.743	-48.939	21.390
600	15.908	20.373	13.221	4.291	-48.717	17.744
700	16.623	22.881	14.425	5.919	-48.483	15.136
800	17.245	25.142	15.625	7.613	-48.242	13.179
900	17.813	27.206	16.799	9.366	-47.994	11.654
1000	18.347	29.111	17.936	11.174	-47.739	10.433
1100	18.854	30.883	19.034	13.035	-47.478	9.432
1200	19.356	32.546	20.091	14.946	-47.212	8.598
1300	19.847	34.114	21.110	16.906	-46.945	7.892
1400	20.321	35.602	22.092	18.914	-46.672	7.286
1500	20.794	37.020	23.041	20.970	-46.398	6.760
1600	21.263	38.377	23.957	23.072	-46.128	6.300
1700	21.728	39.680	24.844	25.222	-45.857	5.895
1800	22.191	40.935	25.703	27.418	-45.588	5.535
1900	22.652	42.148	26.537	29.660	-45.328	5.214
2000	23.111	43.321	27.347	31.948	-45.064	4.924
2100	23.569	44.460	28.135	34.282	-44.815	4.664
2200	24.026	45.567	28.902	36.662	-44.566	4.427
2300	24.482	46.644	29.650	39.088	-44.326	4.212
2400	24.937	47.697	30.380	41.557	-44.094	4.015
2450	25.164	48.213	30.737	42.611	-43.880	3.914
2450	25.164	48.213	30.737	42.611	-43.880	3.914
2400	25.391	48.724	31.094	44.075	-43.542	3.806
2600	25.845	49.728	31.791	46.637	-43.197	3.603
2700	26.298	50.712	32.474	49.244	-42.857	3.415
2800	26.751	51.677	33.142	51.896	-42.530	3.241
2900	27.204	52.624	33.798	54.594	-42.208	3.081
3000	27.656	53.553	34.441	57.337	-41.893	2.931
3100	28.108	54.468	35.072	60.125	-41.583	2.791
3200	28.560	55.367	35.693	62.959	-41.278	2.661
3270	28.876	55.989	36.120	64.969	-41.000	2.575
3270	28.876	55.989	36.120	64.969	-41.000	2.575
3300	29.011	56.257	36.305	65.837	-40.828	2.535
3373	29.341	56.891	36.741	67.967	-40.582	2.441
3373	30.000	62.821	36.741	87.967	-45.108	2.441
3400	30.000	63.060	36.949	88.777	-44.934	2.418
3500	30.000	63.930	37.707	91.777	-44.284	2.336
3600	30.000	64.775	38.448	94.777	-43.634	2.260
3700	30.000	65.597	39.170	97.777	-42.984	2.189
3800	30.000	66.397	39.876	100.777	-42.334	2.122
3900	30.000	67.176	40.566	103.777	-41.684	2.061
3969.46	30.000	67.709	41.040	105.876	-41.228	2.020
3969.46	30.000	67.709	41.040	105.876	-41.228	2.020
4000	30.000	67.935	41.241	106.777	-41.074	1.993
4100	30.000	68.676	41.901	109.777	-40.422	1.926
4200	30.000	69.399	42.547	112.777	-39.771	1.872
4300	30.000	70.105	43.180	115.777	-39.120	1.824
4400	30.000	70.795	43.800	118.777	-38.469	1.782
4500	30.000	71.469	44.417	121.777	-37.818	1.742
4600	30.000	72.128	45.003	124.777	-37.167	1.707
4700	30.000	72.773	45.587	127.777	-36.516	1.677
4800	30.000	73.405	46.160	130.777	-35.865	1.647
4900	30.000	74.024	46.722	133.777	-35.214	1.617
5000	30.000	74.630	47.274	136.777	-34.563	1.587
5100	30.000	75.224	47.817	139.777	-33.912	1.557
5200	30.000	75.806	48.349	142.777	-33.261	1.527
5300	30.000	76.378	48.873	145.777	-32.610	1.497
5400	30.000	76.939	49.387	148.777	-31.959	1.467
5500	30.000	77.489	49.893	151.777	-31.308	1.437
5600	30.000	78.030	50.391	154.777	-30.657	1.407
5700	30.000	78.561	50.880	157.777	-30.006	1.377
5706.65	30.000	78.561	50.880	157.777	-30.006	1.377
5706.65	30.000	78.561	50.880	157.777	-30.006	1.377
5800	30.000	79.082	51.362	160.777	-29.355	1.347
5900	30.000	79.595	51.836	163.777	-28.704	1.317
6000	30.000	80.099	52.303	166.777	-28.053	1.287

31 December 1963

HLS

TANTALUM DIBORIDE (TaB₂)

(CONDENSED PHASE)

gfw = 202.59

$$\Delta H_{f298.15}^{\circ} = -50.0 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 10.603 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3373^{\circ}\text{K}$$

$$\Delta H_m = 20.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.665 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 14.212 + 0.44947 \times 10^{-2}T - 0.36017 \times 10^{-6}T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3373^{\circ}\text{K}$$

$$C_p^{\circ} = 30.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$3373^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

TaB₂ has an hexagonal structure of the AlB₂ (C32) type. It has a wide homogeneity range.

Heat of Formation

Rough estimate used.

Heat Capacity and Entropy

Low-temperature data estimated. See text for details. High-temperature data by Mezaki¹ and Neel et al² analyzed in this work and extrapolated to melting point.

Melting and Vaporization

Heat of fusion estimated

References

1. Mezaki, R., M. S. Thesis, U. Wisc. (1961).
2. Neel, D. S. et al, WADD TR 60-924 (1962)

TANTALUM DIBORIDE (TaB₂)

(CONDENSED PHASE)

GFW = 202.59

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal °K gfw			kcal gfw			Log K _p
	C _p ^o	S _T	-(F _T - H ₂₉₈)/T	H _T - H ₂₉₈	ΔH _f ^o	ΔF _f ^o	
298.15	± 1.000	± 1.000	± 1.000	± 0.000	± 10.000		
1000	± 1.000	± 2.210	± 1.508	± 0.702			
2000	± 1.000	± 2.903	± 2.052	± 1.702			
2450	± 1.000	± 3.106	± 2.228	± 2.152			
2450	± 2.000	± 3.106	± 2.228	± 2.152			
3000	± 2.000	± 3.511	± 2.427	± 3.252			
3373	± 2.000	± 3.746	± 2.560	± 3.998			
3373	± 4.000	± 5.228	± 2.560	± 8.998			
4000	± 4.000	± 5.910	± 3.034	± 11.506			
5000	± 4.000	± 6.803	± 3.701	± 15.506			
6000	± 4.000	± 7.532	± 4.281	± 19.506			

TABLE 94

TITANIUM DIBORIDE

CONDENSED PHASE

B₂Ti

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Ti from 0° to 1950°K, Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K, Solid B from 0° to 2450°K, Liquid B from 2450° to 3970°K, Gaseous B from 3970° to 6000°K, Solid TiB₂ from 0° to 3193°K, Liquid TiB₂ from 3193° to 6000°K.

T, °K	C_p	S_T	$-(F_T - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.381	-66.501	-66.501	INFINITE
298.15	10.503	6.700	6.700	0.000	-66.850	-65.832	48.254
300	10.579	6.765	6.700	0.020	-66.853	-65.828	47.953
400	13.373	10.241	7.155	1.234	-66.933	-65.471	35.770
500	14.868	13.400	8.094	2.653	-67.001	-65.096	28.452
600	15.851	16.202	9.217	4.191	-67.086	-64.711	23.570
700	16.592	18.704	10.397	5.815	-67.186	-64.306	20.076
800	17.204	20.960	11.578	7.506	-67.303	-63.887	17.452
900	17.741	23.018	12.737	9.253	-67.437	-63.452	15.407
1000	18.232	24.913	13.861	11.052	-67.582	-63.001	13.768
1100	18.692	26.673	14.947	12.899	-67.735	-62.536	12.424
1155	18.936	27.591	15.527	13.933	-67.823	-62.273	11.783
1155	18.936	27.591	15.527	13.933	-68.773	-62.273	11.783
1200	19.132	28.318	15.993	14.790	-68.864	-62.019	11.295
1300	19.557	29.866	17.001	16.725	-69.001	-61.446	10.329
1400	19.972	31.331	17.973	18.701	-69.159	-60.858	9.500
1500	20.379	32.723	18.910	20.719	-69.309	-60.257	8.779
1600	20.779	34.051	19.815	22.777	-69.452	-59.652	8.148
1700	21.176	35.322	20.690	24.874	-69.584	-59.033	7.589
1800	21.568	36.544	21.537	27.012	-69.701	-58.410	7.092
1900	21.958	37.720	22.358	29.188	-69.806	-57.781	6.646
1950	22.152	38.293	22.760	30.291	-69.851	-57.465	6.440
2000	22.152	38.293	22.760	30.291	-73.551	-57.465	6.440
2000	22.345	38.857	23.155	31.403	-73.568	-57.048	6.234
2100	22.731	39.956	23.929	33.657	-73.576	-56.226	5.851
2200	23.115	41.021	24.682	35.949	-73.558	-55.401	5.503
2300	23.498	42.058	25.415	38.280	-73.509	-54.577	5.186
2400	23.880	43.067	26.130	40.649	-73.428	-53.753	4.895
2450	24.070	43.561	26.480	41.848	-73.375	-53.240	4.749
2450	24.070	43.561	26.480	41.848	-84.645	-53.240	4.749
2500	24.260	44.049	26.827	43.056	-84.587	-52.607	4.599
2600	24.640	45.008	27.508	45.501	-84.442	-51.331	4.315
2700	25.020	45.945	28.173	47.984	-84.259	-50.059	4.052
2800	25.398	46.862	28.824	50.505	-84.038	-48.793	3.808
2900	25.777	47.760	29.462	53.064	-83.779	-47.542	3.583
3000	26.155	48.640	30.087	55.660	-83.483	-46.297	3.373
3100	26.532	49.504	30.697	58.295	-83.148	-45.060	3.177
3193	26.883	50.293	31.258	60.778	-82.803	-43.924	3.006
3193	25.000	57.193	31.258	82.810	-81.771	-43.924	3.006
3200	25.000	57.248	31.315	82.985	-80.758	-43.887	2.997
3300	25.000	58.017	32.113	85.485	-80.558	-43.364	2.872
3400	25.000	58.764	32.886	87.985	-80.358	-42.846	2.754
3500	25.000	59.488	33.635	90.485	-80.158	-42.332	2.643
3550	25.000	59.840	33.999	91.735	-80.058	-42.071	2.590
3550	25.000	59.840	33.999	91.735	-162.515	-42.071	2.590
3600	25.000	60.193	34.363	92.985	-162.420	-40.379	2.451
3700	25.000	60.878	35.071	95.485	-162.240	-36.995	2.185
3800	25.000	61.544	35.759	97.985	-162.074	-33.608	1.933
3900	25.000	62.194	36.428	100.485	-161.922	-30.237	1.694
3969.96	25.000	62.637	36.814	102.234	-161.821	-27.583	1.518
3969.96	25.000	62.637	36.814	102.234	-402.965	-27.583	1.518
4000	25.000	62.827	37.080	102.985	-402.772	-25.026	1.367
4100	25.000	63.444	37.716	105.485	-402.14	-15.596	0.831
4200	25.000	64.046	38.315	107.985	-401.521	-6.173	0.321
4300	25.000	64.635	38.877	110.485	-400.919	3.244	-0.165
4400	25.000	65.209	39.531	112.985	-400.327	12.632	-0.627
4500	25.000	65.771	40.108	115.485	-399.746	22.007	-1.069
4600	25.000	66.321	40.672	117.985	-399.175	31.369	-1.490
4700	25.000	66.858	41.223	120.485	-398.617	40.728	-1.894
4800	25.000	67.385	41.763	122.985	-398.070	50.073	-2.280
4900	25.000	67.900	42.291	125.485	-397.534	59.399	-2.649
5000	25.000	68.405	42.808	127.985	-397.006	68.725	-3.004
5100	25.000	68.900	43.315	130.485	-396.489	78.031	-3.344
5200	25.000	69.386	43.812	132.985	-395.983	87.330	-3.670
5300	25.000	69.862	44.299	135.485	-395.484	96.613	-3.984
5400	25.000	70.329	44.776	137.985	-394.996	105.896	-4.286
5500	25.000	70.788	45.245	140.485	-394.514	115.178	-4.577
5600	25.000	71.238	45.705	142.985	-394.042	124.429	-4.856
5700	25.000	71.681	46.157	145.485	-393.579	133.693	-5.126
5800	25.000	72.116	46.601	147.985	-393.121	142.930	-5.385
5900	25.000	72.543	47.037	150.485	-392.673	152.176	-5.637
6000	25.000	72.963	47.466	152.985	-392.231	161.408	-5.879

15 March 1963

HLS

$$\Delta H_{f298.15}^{\circ} = -66.85 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 6.7 \pm 0.5 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3193^{\circ}\text{K}$$

$$\Delta H_m = 22.032 \pm 50 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.381 \text{ Kcal gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3193^{\circ}\text{K}$$

$$C_p^{\circ} = 14.99 + 3.74 \times 10^{-3}T - 4.98 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$C_p^{\circ} = 25.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \text{ (estd.) above } T = 3193^{\circ}\text{K}$$

Structure

TiB₂ is of the hexagonal, AlB₂(C32) structure with a narrow homogeneity range.

Heat of Formation

Calorimetric value of Epel'baum and Starostina¹ were chosen. It was consistent within about ± 3 Kcal with vaporization data and nitride equilibria. See text for details.

Heat Capacity and Entropy

Low temperature data were estimated. High temperature data from Kelley,² in agreement with other data, were used. See volume 1, this report for details. Heat capacity above melting point was estimated.

Melting and Heat of Sublimation

Melting point by Post *et al.*³ Heat of fusion estimated.

References

1. Epel'baum, V. A. and M. I. Starostina, Chem. Abst. 54, 23701 (1960).
2. Kelley, K. K., Bur. Mines, Bull. 584 (1960).
3. Post, B., F. W. Glaser and D. Moskowitz, Acta. Met. 2, 20-5 (1954).

TITANIUM DIBORIDE (TiB₂)

(CONDENSED PHASE)

GFW = 69.54

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$(H_T^{\circ} - H_{298}^{\circ})$	ΔH_f°	ΔF_f°	$\log K_p$
298.15	± 0.300	± 0.500	± 0.500	± 0.000			
1000	± 0.650	± 0.863	± 0.652	± 0.211			
2000	± 1.500	± 1.556	± 0.951	± 1.211			
3000	± 2.000	± 2.367	± 1.297	± 3.211			
3193	± 2.000	± 2.492	± 1.365	± 3.597			
3193	± 3.000	± 4.058	± 1.365	± 8.597			
4000	± 3.000	± 4.734	± 1.979	± 11.018			
5000	± 3.000	± 5.403	± 2.600	± 14.018			
6000	± 3.000	± 5.950	± 3.114	± 17.018			

TABLE 95

ZIRCONIUM DIBORIDE

CONDENSED PHASE

B₂Zr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Zr from 0° to 2125°K, Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K, Solid B from 0° to 2450°K, Liquid B from 2450° to 3970°K, Gaseous B from 3970° to 6000°K, Solid ZrB₂ from 0° to 3313°K, Liquid ZrB₂ from 3313° to 6000°K.

T, °K	C_p	S°	$-(F^\circ - H_{298}^\circ)/T$	$(H_T - H_{298})$	ΔH_f	ΔF_f	$\log K_p$
0	0.000	0.000	INFINITE	-1.590	-72.697	-72.697	INFINITE
298.15	11.530	8.590	8.590	0.000	-73.000	-71.961	52.746
300	11.596	8.662	8.590	0.021	-73.002	-71.957	52.418
400	14.077	12.374	9.080	1.320	-73.008	-71.606	39.122
500	15.467	15.681	10.077	2.802	-73.037	-71.251	31.142
600	16.427	18.590	11.259	4.399	-73.091	-70.892	25.821
700	17.185	21.181	12.494	6.081	-73.162	-70.518	22.016
800	17.835	23.519	13.729	7.832	-73.251	-70.135	19.159
900	18.422	25.654	14.937	9.646	-73.352	-69.739	16.934
1000	18.970	27.624	16.108	11.516	-73.462	-69.331	15.152
1100	19.493	29.457	17.240	13.439	-73.577	-68.913	13.691
1135	19.671	30.070	17.626	14.124	-73.618	-68.764	13.240
1135	19.671	30.070	17.626	14.124	-74.533	-68.764	13.240
1200	19.998	31.175	18.330	15.414	-74.595	-68.433	12.463
1300	20.491	32.795	19.381	17.438	-74.675	-67.917	11.417
1400	20.975	34.331	20.394	19.511	-74.736	-67.494	10.520
1500	21.452	35.795	21.373	21.633	-74.772	-66.866	9.742
1600	21.925	37.194	22.318	23.802	-74.783	-66.341	9.061
1700	22.393	38.537	23.233	26.018	-74.765	-65.812	8.460
1800	22.859	39.831	24.119	28.280	-74.717	-65.287	7.927
1900	23.322	41.079	24.972	30.589	-74.638	-64.767	7.450
2000	23.784	42.287	25.815	32.945	-74.524	-64.248	7.020
2100	24.243	43.458	26.627	35.346	-74.375	-63.741	6.633
2125	24.358	43.746	26.827	35.954	-74.332	-63.616	6.542
2125	24.358	43.746	26.827	35.954	-79.232	-63.616	6.542
2200	24.702	44.597	27.418	37.793	-79.099	-63.065	6.265
2300	25.154	45.705	28.189	40.286	-78.888	-62.342	5.924
2400	25.615	46.785	28.944	42.825	-78.637	-61.626	5.612
2450	25.843	47.316	29.311	44.112	-78.496	-61.171	5.456
2450	25.843	47.316	29.311	44.112	-85.766	-61.171	5.456
2500	26.071	47.840	29.677	45.409	-89.619	-60.595	5.297
2600	26.526	48.872	30.395	48.039	-89.289	-59.438	4.996
2700	26.981	49.881	31.098	50.715	-88.913	-58.299	4.719
2800	27.435	50.871	31.787	53.435	-88.493	-57.172	4.462
2900	27.888	51.841	32.467	56.202	-88.026	-56.061	4.225
3000	28.342	52.795	33.123	59.013	-87.515	-54.964	4.004
3100	28.795	53.731	33.773	61.870	-86.958	-53.885	3.799
3200	29.247	54.653	34.411	64.772	-86.356	-52.810	3.608
3300	29.700	55.559	35.038	67.719	-85.709	-51.794	3.430
3313	29.758	55.676	35.119	68.106	-85.620	-51.658	3.408
3313	29.758	55.676	35.119	68.106	-60.620	-51.658	3.408
3400	29.758	56.194	35.848	70.695	-60.033	-51.434	3.306
3500	29.758	56.856	36.665	73.671	-59.357	-51.192	3.196
3600	29.758	57.565	37.460	76.646	-58.687	-50.964	3.094
3700	29.758	58.310	38.234	79.622	-58.006	-50.759	2.998
3800	29.758	59.094	38.988	82.598	-57.330	-50.569	2.908
3900	29.758	59.917	39.724	85.574	-56.654	-50.403	2.824
3969.96	29.758	60.606	40.423	88.550	-56.180	-50.292	2.768
3969.96	29.758	60.606	40.423	88.550	-29.324	-50.292	2.768
4000	29.758	61.330	41.144	91.525	-29.696	-48.420	2.645
4100	29.758	62.094	41.829	94.501	-29.061	-47.225	2.551
4200	29.758	62.897	42.495	97.477	-28.373	-46.053	2.476
4300	29.758	63.740	43.144	100.453	-27.627	-44.901	2.412
4400	29.758	64.623	43.777	103.429	-26.821	-43.769	2.358
4500	29.758	65.546	44.394	106.405	-25.955	-42.661	2.312
4600	29.758	66.509	45.000	109.381	-25.029	-41.585	2.272
4644.05	29.758	67.512	45.594	112.357	-24.053	-40.549	2.236
4644.05	29.758	67.512	45.594	112.357	-424.843	-8.977	0.422
4700	29.758	68.555	46.177	115.333	-424.240	-3.966	0.184
4800	29.758	69.638	46.749	118.309	-423.169	4.962	-0.226
4900	29.758	70.761	47.311	121.285	-422.106	13.867	-0.618
5000	29.758	71.924	47.863	124.261	-421.047	22.760	-0.995
5100	29.758	73.127	48.405	127.237	-419.996	31.616	-1.355
5200	29.758	74.370	48.937	130.213	-418.953	40.469	-1.701
5300	29.758	75.653	49.459	133.189	-417.914	49.282	-2.032
5400	29.758	76.976	49.971	136.165	-416.882	58.090	-2.351
5500	29.758	78.339	50.473	139.141	-415.853	66.887	-2.658
5600	29.758	79.742	50.965	142.117	-414.833	75.646	-2.952
5700	29.758	81.185	51.447	145.093	-413.819	84.405	-3.236
5800	29.758	82.668	51.919	148.069	-412.806	93.129	-3.509
5900	29.758	84.191	52.381	151.045	-411.802	101.846	-3.772
6000	29.758	85.754	52.833	154.021	-410.802	110.552	-4.027

15 March 1963

HLS

$$\Delta H_{f298.15}^{\circ} = -73.0 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 8.59 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3313^{\circ}\text{K}$$

$$\Delta H_m = 25.000 \pm 5.000 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.590 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 14.888 + 4.50 \times 10^{-3}T - 4.178 \times 10^{-5}T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3313^{\circ}\text{K}$$

Structure

ZrB₂ is of the hexagonal AlB₂ (C32) structure with a narrow homogeneity range.

Heat of Formation

The value chosen is based primarily on three calorimetric determinations^{1, 2, 3} and is in general agreement with vaporization studies.^{4, 5}

Heat Capacity and Entropy

Low temperature data by Westrum and Feick.⁶ This data was joined by the Shomate method to Margrave⁷ and Southern Research Institute data.⁸

Melting and Heat of Sublimation

Melting temperature from Glaser and Post.⁹ Heat of fusion estimated.

References

1. Hubbard, W., J. Margrave and E. Greenberg, private communication with E. Greenberg (December 1962).
2. Huber, E. J., E. L. Head and C. E. Holley, unpublished work quoted by Leitnaker et al.⁴
3. Epel'baum, V. A. and M. I. Starostina, Bor Trudy Konf. Khim Bora i Ego Soedinenii 1955, 97 published (1958).
4. Leitnaker, J. M., M. G. Bowman and P. W. Gilles, J. Chem. Phys. **36**, 350 (1962).
5. Goldstein, H. W. and O. C. Trulson, Union Carbide Corporation Rept. (31 December 1962).
6. Westrum, E. and G. Feick, J. Chem. Eng. Data **8**, 193 (1963).
7. Margrave, J. L., in: A. D. Little Third Semiannual Progress Rept., Contract AF33(616)-7472 (August 1962).
8. Neel, D. S., C. D. Pears and S. Oglesby, Jr., Southern Research Inst., WADD TR-60-924 (1960).
9. Glaser, F. W. and B. Post, Trans. A.I.M.E. **197**, 1117 (1953).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.300	± 0.050	± 0.050	± 0.000	± 2.000		
1000	± 1.000	± 0.898	± 0.338	± 0.561			
2000	± 2.000	± 1.879	± 0.849	± 2.061			
3000	± 2.000	± 2.690	± 1.336	± 4.061			
3313	± 2.000	± 2.888	± 1.474	± 4.687			
3313	± 4.000	± 4.398	± 1.474	± 9.687			
4000	± 4.000	± 5.151	± 2.043	± 12.435			
5000	± 4.000	± 6.044	± 2.757	± 16.435			
6000	± 4.000	± 6.773	± 3.368	± 20.435			

TABLE 96

BERYLLIUM

REFERENCE STATE

Be

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$
 Solid Be from 0° to 1556°K, Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K

T, °K	C_p°	S_T°	$(F_T - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-0.467			
298.15	3.932	2.282	2.282	0.000			
300	3.951	2.317	2.283	0.007			
400	4.773	3.565	2.447	0.447			
500	5.260	4.687	2.787	0.950			
600	5.588	5.676	3.186	1.494			
700	5.846	6.557	3.606	2.066			
800	6.072	7.353	4.025	2.662			
900	6.287	8.081	4.437	3.280			
1000	6.508	8.754	4.835	3.919			
1100	6.720	9.384	5.219	4.582			
1200	6.938	9.978	5.590	5.266			
1300	7.156	10.542	5.949	5.971			
1400	7.374	11.080	6.296	6.697			
1500	7.592	11.596	6.633	7.445			
1556	7.714	11.877	6.817	7.874			
1556	6.878	14.139	6.817	11.394			
1600	6.901	14.331	7.021	11.697			
1700	6.952	14.751	7.464	12.390			
1800	7.004	15.150	7.880	13.088			
1900	7.055	15.530	8.273	13.791			
2000	7.107	15.893	8.645	14.499			
2100	7.158	16.241	9.000	15.212			
2200	7.209	16.575	9.337	15.930			
2300	7.261	16.897	9.659	16.654			
2400	7.312	17.207	9.968	17.387			
2500	7.364	17.507	10.264	18.116			
2600	7.415	17.796	10.548	18.855			
2700	7.466	18.077	10.822	19.599			
2767.61	7.501	18.281	11.002	20.108			
2767.61	4.994	43.117	11.002	90.277			
2800	4.997	43.475	11.316	90.437			
2900	5.007	43.851	12.493	90.937			
3000	5.021	44.021	13.542	91.438			
3100	5.037	44.186	14.528	91.941			
3200	5.057	44.346	15.457	92.446			
3300	5.081	44.502	16.334	92.943			
3400	5.109	44.654	17.165	93.452			
3500	5.142	44.803	17.953	93.975			
3600	5.179	44.948	18.700	94.491			
3700	5.221	45.090	19.412	95.010			
3800	5.268	45.230	20.089	95.535			
3900	5.320	45.368	20.736	96.064			
4000	5.378	45.503	21.353	96.599			
4100	5.440	45.637	21.944	97.140			
4200	5.508	45.769	22.510	97.687			
4300	5.581	45.899	23.052	98.242			
4400	5.658	46.028	23.573	98.804			
4500	5.741	46.156	24.073	99.373			
4600	5.828	46.283	24.554	99.952			
4700	5.919	46.410	25.019	100.539			
4800	6.014	46.535	25.465	101.136			
4900	6.113	46.660	25.896	101.742			
5000	6.215	46.785	26.313	102.358			
5100	6.320	46.909	26.716	102.985			
5200	6.428	47.033	27.106	103.622			
5300	6.538	47.156	27.482	104.271			
5400	6.649	47.279	27.848	104.930			
5500	6.763	47.402	28.202	105.601			
5600	6.877	47.525	28.546	106.283			
5700	6.993	47.648	28.880	106.976			
5800	7.108	47.771	29.205	107.681			
5900	7.224	47.893	29.520	108.398			
6000	7.340	48.016	29.828	109.126			

15 September 1962

RCF

BERYLLIUM (Be)

(REFERENCE STATE)

gfw = 9.013

0 °K to 1556 °K Crystal

1556 °K to 2767.61 °K Liquid

2767.61 °K to 6000 °K Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{s298.15}^{\circ} = 78.0 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 2.282 \pm .020 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 1556^{\circ} \pm 3^{\circ} \text{ K}$$

$$\Delta H_m = 3.520 \pm .080 \text{ Kcal gfw}^{-1}$$

$$T_b = 2768^{\circ} \pm 35^{\circ} \text{ K}$$

$$\Delta H_v = 70.169 \pm .870 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = .467 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 4.322 + 2.18 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 600^{\circ} \text{ K} \leq T \leq 1560^{\circ} \text{ K}$$

$$C_p^{\circ} = 6.079 + 5.138 \times 10^{-4} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1560^{\circ} \text{ K} \leq T \leq 2200^{\circ} \text{ K}$$

(latter equation extrapolated to 2768°K).

StructureH. C. P. to about 20°K below T_m , B. C. C. to T_m Heat of Formation

Zero by definition.

Heat Capacity and EntropyHeat capacities from Kantor, et al¹.MeltingBased on several determinations².VaporizationBased on earlier report².References

1. Kantor, P., et al, Fiz. Met. i. Metalloved 10, 835 (1960).
2. Barriault, R. J., et al, Thermodynamics of Certain Refractory Compounds, ASD TR 61-260 Pt. 1 (May 1962).

BERYLLIUM (Be)

(REFERENCE STATE)

gfw = 9.013

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	S_T	$-(H_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f	ΔG_f	$\log K_p$
298.15	± 0.050	± 0.020	± 0.020	± 0.000			
1000	± 0.050	± 0.070	± 0.030	± 0.040			
1556	± 0.050	± 0.100	± 0.060	± 0.060			
1556	± 0.100	± 0.155	± 0.060	± 0.140			
2000	± 0.150	± 0.185	± 0.080	± 0.200			
2767.61	± 0.300	± 0.255	± 0.120	± 0.320			
2767.61	± 0.001	± 0.002	± 0.003	± 0.001			
3000	± 0.001	± 0.002	± 0.001	± 0.001			
4000	± 0.002	± 0.003	± 0.003	± 0.002			
5000	± 0.002	± 0.003	± 0.003	± 0.004			
6000	± 0.002	± 0.003	± 0.004	± 0.005			

TABLE 97

BERYLLIUM

IDEAL MONATOMIC GAS

Be

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$
 Solid Be from 0° to 1556°K, Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K

T, °K	C_p	S_I°	$(H_I^\circ - H_{298}^\circ)/T$	$(H_T^\circ - H_{298}^\circ)$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	76.986	76.986	INFINITE
298.15	4.968	32.545	32.545	0.000	78.000	68.977	-50.559
300	4.968	32.576	32.545	0.009	78.002	68.921	-50.206
400	4.968	34.005	32.740	0.506	78.059	65.883	-35.995
500	4.968	35.114	33.108	1.003	78.053	62.839	-27.466
600	4.968	36.020	33.520	1.500	78.006	59.800	-21.781
700	4.968	36.785	33.933	1.996	77.930	56.700	-17.724
800	4.968	37.449	34.332	2.493	77.831	53.754	-14.684
900	4.968	38.034	34.712	2.990	77.710	50.752	-12.324
1000	4.968	38.557	35.070	3.487	77.568	47.765	-10.439
1100	4.968	39.031	35.409	3.984	77.402	44.791	-8.899
1200	4.968	39.463	35.729	4.481	77.215	41.833	-7.618
1300	4.968	39.861	36.032	4.977	77.006	38.892	-6.538
1400	4.968	40.229	36.319	5.474	76.777	35.968	-5.615
1500	4.968	40.572	36.591	5.971	76.526	33.063	-4.817
1556	4.968	40.754	36.738	6.249	76.375	31.443	-4.416
1556	4.968	40.754	36.738	6.249	77.855	31.443	-4.416
1600	4.968	40.892	36.850	6.468	72.771	30.274	-4.135
1700	4.968	41.194	37.097	6.965	72.575	27.624	-3.551
1800	4.968	41.478	37.322	7.461	72.373	24.986	-3.034
1900	4.968	41.746	37.558	7.958	72.165	22.359	-2.572
2000	4.969	42.001	37.774	8.455	71.956	19.742	-2.157
2100	4.969	42.244	37.981	8.952	71.740	17.140	-1.784
2200	4.970	42.475	38.180	9.449	71.519	14.545	-1.445
2300	4.972	42.696	38.371	9.946	71.292	11.962	-1.137
2400	4.974	42.907	38.556	10.443	71.061	9.389	-0.855
2500	4.977	43.110	38.734	10.941	70.875	6.825	-0.597
2600	4.982	43.306	38.906	11.439	70.584	4.269	-0.359
2700	4.988	43.494	39.073	11.937	70.338	1.722	-0.139
2767.61	4.994	43.617	39.182	12.277	70.169	0.000	0.000
2767.61	4.994	43.617	39.182	12.277			
2800	4.997	43.675	39.234	12.437			
2900	5.007	43.851	39.390	12.937			
3000	5.021	44.021	39.542	13.438			
3100	5.037	44.186	39.689	13.941			
3200	5.057	44.346	39.832	14.446			
3300	5.081	44.502	39.971	14.953			
3400	5.109	44.654	40.106	15.462			
3500	5.142	44.803	40.238	15.975			
3600	5.179	44.948	40.367	16.491			
3700	5.221	45.090	40.493	17.010			
3800	5.268	45.230	40.616	17.535			
3900	5.320	45.368	40.736	18.064			
4000	5.378	45.503	40.853	18.599			
4100	5.440	45.637	40.968	19.140			
4200	5.508	45.769	41.081	19.687			
4300	5.581	45.899	41.192	20.242			
4400	5.658	46.028	41.300	20.804			
4500	5.741	46.156	41.407	21.373			
4600	5.828	46.283	41.511	21.952			
4700	5.919	46.410	41.614	22.539			
4800	6.014	46.535	41.715	23.136			
4900	6.113	46.660	41.815	23.742			
5000	6.215	46.785	41.913	24.358			
5100	6.320	46.909	42.011	24.985			
5200	6.428	47.033	42.105	25.622			
5300	6.538	47.156	42.199	26.271			
5400	6.649	47.279	42.292	26.930			
5500	6.763	47.402	42.384	27.601			
5600	6.877	47.525	42.475	28.283			
5700	6.993	47.648	42.565	28.976			
5800	7.108	47.771	42.653	29.681			
5900	7.224	47.893	42.741	30.398			
6000	7.340	48.016	42.828	31.126			

RCF

BERYLLIUM, MONATOMIC (Be) (IDEAL GAS)

gfw = 9.013

$$\Delta H_{f0}^{\circ} = 76.986 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 78.000 \pm .500 \text{ kcal gfw}^{-1}$$

Ground State Configuration = $1S_0$

$$S_{298.15}^{\circ} = 32.545 \pm .002 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ Kcal gfw}^{-1}$$

Electronic levels and multiplicitiesAll levels from Moore¹Heat of FormationBased on previous report.²Heat Capacity and Entropy

Calculated using monatomic-gas program.

References

1. Moore, C., NBS Circular 467, Vol. 1 (15 June 1949).
2. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds, ASD TR 61-760, Part I (May 1962)

BERYLLIUM, MONATOMIC (Be)

(IDEAL GAS)

gfw = 9.013

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	S_T	$-(F_T - H_0^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔH_f°	$1/R \ln K_p$
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 0.510	± 0.370
1000	± 0.000	± 0.007	± 0.002	± 0.000	± 0.540	± 0.530	± 0.120
1556	± 0.000	± 0.002	± 0.002	± 0.000	± 0.560	± 0.580	± 0.080
1556	± 0.000	± 0.055	± 0.002	± 0.080	± 0.640	± 0.580	± 0.108
2000	± 0.000	± 0.057	± 0.003	± 0.080	± 0.700	± 0.670	± 0.070
2767.61	± 0.000	± 0.057	± 0.003	± 0.080	± 0.870	± 0.840	± 0.070
2767.61	± 0.000	± 0.386	± 0.003	± 0.950			
3000	± 0.001	± 0.388	± 0.003	± 0.951			
4000	± 0.002	± 0.391	± 0.003	± 0.952			
5000	± 0.002	± 0.391	± 0.003	± 0.954			
6000	± 0.002	± 0.391	± 0.004	± 0.955			

TABLE 98

BERYLLIUM OXIDE

CONDENSED PHASE

BeO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Be from 0° to 1556°K,
 Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K, Gaseous O₂,
 Solid BeO from 0° to 2820°K, Liquid BeO from 2820° to 4500°K.

T, °K	C_p	C_p	$(H_T - H_{298})/T$	H_T	H_{298}	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-0.687	-142.283	-142.283	INFINITE	
298.15	6.105	3.376	3.376	0.000	-143.100	-136.120	99.774	
300	6.148	3.414	3.376	0.011	-143.103	-136.077	99.127	
400	8.803	5.467	3.643	0.730	-143.178	-133.722	73.059	
500	9.310	7.412	4.204	1.604	-143.173	-131.355	57.412	
600	10.128	9.186	4.889	2.578	-143.121	-128.997	46.985	
700	10.714	10.793	5.619	3.622	-143.038	-126.649	39.540	
800	11.154	12.254	6.359	4.716	-142.939	-124.314	33.959	
900	11.498	13.588	7.089	5.849	-142.831	-121.991	29.622	
1000	11.776	14.815	7.801	7.014	-142.718	-119.683	26.155	
1100	12.005	15.948	8.491	8.203	-142.612	-117.386	23.321	
1200	12.197	17.001	9.157	9.413	-142.510	-115.099	20.961	
1300	12.361	17.984	9.798	10.641	-142.415	-112.818	18.965	
1400	12.503	18.905	10.416	11.885	-142.329	-110.546	17.256	
1500	12.628	19.772	11.011	13.142	-142.256	-108.276	15.775	
1556	12.723	20.235	11.333	13.851	-142.221	-107.007	15.029	
1556	12.723	20.235	11.333	13.851	-145.741	-107.007	15.029	
1600	12.815	20.592	11.584	14.412	-145.676	-105.913	14.466	
1700	13.024	21.375	12.147	15.704	-145.519	-103.432	13.297	
1800	13.233	22.125	12.671	17.017	-145.348	-100.960	12.258	
1900	13.442	22.846	13.188	18.351	-145.164	-98.499	11.330	
2000	13.651	23.541	13.688	19.706	-144.967	-96.048	10.495	
2100	13.860	24.212	14.174	21.081	-144.758	-93.605	9.741	
2200	14.069	24.867	14.645	22.478	-144.534	-91.176	9.057	
2300	14.278	25.497	15.103	23.895	-144.300	-88.753	8.433	
2400	14.487	26.104	15.549	25.333	-144.051	-86.342	7.862	
2500	14.696	26.699	15.982	26.792	-143.789	-83.940	7.338	
2600	14.905	27.280	16.406	28.277	-143.515	-81.555	6.855	
2700	15.114	27.846	16.819	29.774	-143.225	-79.175	6.408	
2767.61	15.256	28.223	17.094	30.806	-143.023	-77.565	6.124	
2767.61	15.256	28.223	17.094	30.806	-213.192	-77.565	6.124	
2800	15.323	28.400	17.223	31.295	-213.014	-75.998	5.932	
2820	15.365	28.509	17.303	31.602	-212.902	-75.039	5.815	
2820	17.000	33.984	17.303	47.042	-197.462	-75.039	5.815	
2900	17.000	34.459	17.769	48.402	-196.880	-71.551	5.392	
3000	17.000	35.036	18.335	50.102	-196.158	-67.239	4.898	
3100	17.000	35.593	18.802	51.802	-195.439	-62.956	4.438	
3200	17.000	36.133	19.414	53.502	-194.725	-58.694	4.008	
3300	17.000	36.656	19.928	55.202	-194.015	-54.455	3.606	
3400	17.000	37.164	20.428	56.902	-193.308	-50.236	3.229	
3500	17.000	37.656	20.913	58.602	-192.608	-46.038	2.875	
3600	17.000	38.135	21.384	60.302	-191.913	-41.861	2.541	
3700	17.000	38.601	21.844	62.002	-191.223	-37.702	2.227	
3800	17.000	39.054	22.290	63.702	-190.541	-33.561	1.930	
3900	17.000	39.496	22.726	65.402	-189.864	-29.433	1.650	
4000	17.000	39.926	23.150	67.102	-189.195	-25.332	1.384	
4100	17.000	40.346	23.565	68.802	-188.534	-21.244	1.132	
4200	17.000	40.756	23.970	70.502	-187.881	-17.171	0.893	
4300	17.000	41.156	24.365	72.202	-187.238	-13.115	0.667	
4400	17.000	41.547	24.751	73.902	-186.603	-9.072	0.451	
4500	17.000	41.929	25.129	75.602	-185.978	-5.049	0.245	

RCF

BERYLLIUM OXIDE (BeO) (CONDENSED PHASE)

gfw = 25.013

$$\Delta H^\circ_{f298.15} = -143.100 \pm \text{Kcal gfw}^{-1} \quad S^\circ_{298.15} = 3.376 \pm .050 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2820^\circ \text{K}$$

$$\Delta H_m = 15.440 \pm .500 \text{ Kcal gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 0.687 \text{ Kcal gfw}^{-1}$$

$$C^\circ_p = 17 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2820^\circ \text{K} \leq T \leq 4500^\circ \text{K}$$

Structure

Solid has hexagonal (wurtzite-type) structure.

Heat of Formation

Cosgrove and Snyder¹

Heat Capacity and Entropy

Heat capacities of solid from Victor and Douglas² for $T < 1500^\circ \text{K}$ and from Kandyba, et al³ for $T > 1500^\circ \text{K}$.

Melting and Vaporization

Based on the mass spectrometric results of Chupka, et al⁴.

References

1. Cosgrove, L.A. and P.E. Snyder, J. Am. Chem. Soc. 75, 3102 (1953)
2. Victor and Douglas, NBS Report 6484 (1959).
3. Kandyba, V. V., et al., Doklady Akad. Nauk SSSR 131, 566 (1960).
4. Chupka W.A., J. Berkowitz, and C.F. Giese, J. Chem. Phys. 30, 827 (1959).

BERYLLIUM MONOXIDE (BeO)

(CONDENSED PHASE)

GFW = 25.013

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p	S _T	-(F _T - H ₂₉₈) / T	H _T - H ₂₉₈	ΔH _f	ΔF _f	
298.15	± 0.100	± 0.050	± 0.050	± 0.000	± 4.000	± 4.000	± 2.950
1000	± 0.300	± 0.150	± 0.080	± 0.070	± 4.110	± 4.110	± 0.900
2000	± 0.700	± 0.290	± 0.150	± 0.270	± 4.470	± 4.460	± 0.490
2820	± 1.580	± 0.444	± 0.220	± 0.630	± 5.500	± 5.460	± 0.420
2820	± 1.000	± 0.620	± 0.220	± 1.130	± 6.000	± 5.960	± 0.420
4000	± 2.000	± 1.140	± 0.420	± 2.900	± 7.780	± 6.530	± 0.360

TABLE 99

BERYLLIUM OXIDE

IDEAL MOLECULAR GAS

BeO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Be from 0° to 1556°K, Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K; Gaseous O₂, Gaseous BeO.

T, °K	\bar{c}_p	\bar{c}_T	$-(F_T^\circ - H_{298}^\circ)/T$	$\bar{H}_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.077	29.547	29.547	INFINITE
298.15	7.046	47.209	47.209	0.000	30.120	24.031	-17.614
300	7.049	47.252	47.209	0.013	30.119	23.993	-17.478
400	7.254	49.346	47.488	0.727	30.039	21.960	-11.998
500	7.510	50.952	48.021	1.465	29.908	19.956	-8.723
600	7.757	52.344	48.628	2.229	29.750	17.980	-6.549
700	7.970	53.556	49.248	3.016	29.576	16.031	-5.005
800	8.146	54.632	49.855	3.822	29.387	14.108	-3.854
900	8.289	55.600	50.440	4.644	29.184	12.213	-2.965
1000	8.406	56.480	51.001	5.479	29.967	10.337	-2.259
1100	8.504	57.285	51.536	6.324	28.729	8.484	-1.685
1200	8.588	58.029	52.046	7.179	28.476	6.654	-1.212
1300	8.665	58.720	52.534	8.042	28.206	4.845	-0.814
1400	8.737	59.364	52.999	8.912	27.918	3.058	-0.477
1500	8.810	59.970	53.443	9.789	27.611	1.296	-0.189
1556	8.852	60.290	53.681	10.284	27.446	0.320	-0.045
1556	8.852	60.290	53.681	10.284	27.446	0.320	-0.045
1600	8.885	60.541	53.869	10.674	27.806	-0.349	0.048
1700	8.966	61.082	54.278	11.567	23.564	-1.852	0.238
1800	9.052	61.597	54.670	12.467	23.322	-3.338	0.405
1900	9.146	62.088	54.048	13.377	23.082	-4.813	0.554
2000	9.246	62.560	55.412	14.297	22.844	-6.276	0.686
2100	9.353	63.014	55.763	15.227	22.608	-7.722	0.804
2200	9.465	63.451	56.103	16.167	22.375	-9.163	0.910
2300	9.582	63.875	56.431	17.120	22.145	-10.588	1.006
2400	9.703	64.285	56.750	18.084	21.920	-12.005	1.093
2500	9.827	64.684	57.060	19.061	21.700	-13.415	1.173
2600	9.951	65.072	57.360	20.049	21.482	-14.816	1.245
2700	10.076	65.450	57.653	21.051	21.272	-16.207	1.312
2767.61	10.159	65.700	57.847	21.737	21.128	-17.149	1.354
2767.61	10.159	65.700	57.847	21.737	-49.041	-17.149	1.354
2800	10.199	65.818	57.938	22.065	-49.025	-16.780	1.310
2900	10.320	66.179	58.216	23.091	-48.971	-15.627	1.178
3000	10.437	66.530	58.488	24.128	-48.912	-14.478	1.055
3100	10.551	66.875	58.753	25.178	-48.843	-13.333	0.940
3200	10.659	67.212	59.012	26.239	-48.768	-12.187	0.832
3300	10.763	67.541	59.266	27.310	-48.687	-11.051	0.732
3400	10.861	67.864	59.514	28.391	-48.609	-9.908	0.637
3500	10.953	68.181	59.757	29.482	-48.508	-8.772	0.548
3600	11.038	68.491	59.996	30.582	-48.413	-7.644	0.464
3700	11.118	68.794	60.229	31.690	-48.315	-6.506	0.384
3800	11.191	69.092	60.459	32.806	-48.217	-5.383	0.310
3900	11.258	69.384	60.684	33.929	-48.117	-4.255	0.238
4000	11.319	69.670	60.906	35.058	-48.019	-3.136	0.171
4100	11.374	69.950	61.123	36.193	-47.923	-2.012	0.107
4200	11.423	70.226	61.337	37.333	-47.830	-0.893	0.046
4300	11.467	70.495	61.547	38.478	-47.742	0.222	-0.011
4400	11.506	70.760	61.754	39.628	-47.657	1.335	-0.066
4500	11.540	71.019	61.957	40.780	-47.580	2.445	-0.119
4600	11.570	71.274	62.157	41.937	-47.510	3.555	-0.169
4700	11.595	71.523	62.354	43.096	-47.449	4.670	-0.217
4800	11.617	71.768	62.548	44.257	-47.398	5.770	-0.263
4900	11.635	72.008	62.73	45.421	-47.357	6.874	-0.307
5000	11.649	72.244	62.927	46.586	-47.328	7.985	-0.349
5100	11.661	72.476	63.113	47.752	-47.314	9.088	-0.389
5200	11.669	72.703	63.295	48.920	-47.313	10.199	-0.429
5300	11.676	72.926	63.475	50.088	-47.331	11.300	-0.466
5400	11.680	73.145	63.653	51.257	-47.364	12.403	-0.502
5500	11.682	73.360	63.828	52.427	-47.418	13.505	-0.537
5600	11.682	73.572	64.001	53.597	-47.493	14.614	-0.570
5700	11.681	73.779	64.171	54.766	-47.594	15.722	-0.603
5800	11.678	73.983	64.339	55.936	-47.720	16.838	-0.634
5900	11.674	74.184	64.505	57.105	-47.879	17.942	-0.665
6000	11.670	74.381	64.669	58.274	-48.071	19.062	-0.694

RCF

BERYLLIUM OXIDE (BeO) (IDEAL MOLECULAR GAS) gfw = 25.013

$$\Delta H^{\circ}_{f0} = 29.547 \text{ Kcal gfw}^{-1}$$

$$\Delta H^{\circ}_{f298.15} = 30.120 \pm 3.000 \text{ Kcal gfw}^{-1}$$

Ground State Configuration = $1s^2$

$$S^{\circ}_{298.15} = 47.209 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^{\circ}_{298.15} - H^{\circ}_0 = 2.077 \text{ Kcal gfw}^{-1}$$

Heat of Formation

Derived from data of Chupka et al¹.

Heat Capacity and Entropy

Calculated using diatomic gas program. Spectroscopic constants were from Herzberg.² Stretching constants, D_e values, not given by Herzberg were estimated with Dunham³ equations.

References

1. Chupka, W., et al, J. Chem Phys. 30, 827 (1959).
2. Herzberg, G., Spectra of Diatomic Molecules, Van Nostrand, N.Y. (1950).
3. Dunham, J.L., Phys. Rev. 41, 721 (1932).

TABLE 100

BERYLLIUM CARBIDE

CONDENSED PHASE

Be₂C

Reference State for calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Be from 0° to 1556°K,
 Liquid Be from 1556° to 2767°K, Gaseous Be from 2767° to 6000°K;
 Solid C; Solid Be₂C from 0° to 2400°K, Liquid Be₂C from
 2400° to 3500°K.

T, °K	cal/°K gfw			Kcal/gfw			Log K_p
	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
0							
298.15	10.340	4.000	4.000	0.000	-23.800	-23.227	17.025
300	10.350	4.064	4.000	0.019	-23.799	-23.222	16.917
400	10.860	7.111	4.412	1.080	-23.864	-23.027	12.581
500	11.371	9.590	5.207	2.191	-24.078	-22.793	9.963
600	11.882	11.708	6.118	3.354	-24.381	-22.512	8.200
700	12.392	13.578	7.053	4.568	-24.736	-22.172	6.922
800	12.903	15.266	7.976	5.832	-25.123	-21.782	5.950
900	13.413	16.815	8.873	7.148	-25.530	-21.337	5.181
1000	13.924	18.255	9.740	8.515	-25.947	-20.850	4.557
1100	14.435	19.606	10.576	9.933	-26.378	-20.322	4.037
1200	14.945	20.884	11.382	11.402	-26.813	-19.755	3.598
1300	15.456	22.100	12.160	12.922	-27.252	-19.150	3.219
1400	15.966	23.264	12.912	14.493	-27.689	-18.511	2.890
1500	16.477	24.383	13.640	16.115	-28.127	-17.839	2.599
1556	16.763	24.992	14.037	17.046	-28.372	-17.448	2.451
1556	16.763	24.992	14.037	17.046	-35.412	-17.448	2.451
1600	16.988	25.463	14.345	17.788	-35.528	-16.939	2.314
1700	17.498	26.508	15.030	19.513	-35.763	-15.768	2.027
1800	18.009	27.523	15.696	21.288	-35.963	-14.586	1.771
1900	18.519	28.510	16.345	23.114	-36.125	-13.394	1.541
2000	19.030	29.473	16.977	24.992	-36.248	-12.194	1.332
2100	19.541	30.414	17.595	26.920	-36.333	-10.984	1.143
2200	20.051	31.335	18.198	28.900	-36.380	-9.773	0.971
2300	20.562	32.237	18.789	30.931	-36.389	-8.565	0.814
2400	21.072	33.123	19.368	33.012	-36.369	-7.350	0.669
2400	21.072	40.623	19.368	51.012	-18.369	-7.350	0.669
2500	21.072	41.483	20.235	53.120	-18.315	-6.890	0.602
2600	21.072	42.310	21.069	55.227	-18.285	-6.437	0.541
2700	21.072	43.105	21.870	57.334	-18.266	-5.980	0.484
2767.61	21.072	43.626	22.395	58.759	-18.265	-5.669	0.448
2767.61	21.072	43.626	22.395	58.759	-158.603	-5.669	0.448
2800	21.072	43.871	22.642	59.441	-158.436	-3.900	0.304
2900	21.072	44.611	23.387	61.548	-157.933	1.610	-0.121
3000	21.072	45.325	24.107	63.656	-157.432	7.106	-0.518
3100	21.072	46.016	24.802	65.763	-156.937	12.585	-0.887
3200	21.072	46.685	25.476	67.870	-156.448	18.043	-1.232
3300	21.072	47.334	26.128	69.977	-155.945	23.482	-1.555
3400	21.072	47.963	26.761	72.084	-155.467	28.917	-1.859
3500	21.072	48.573	27.376	74.192	-155.018	34.335	-2.144

15 June 1963

RED

$$\Delta H_{f298.15}^\circ = -23.8 \pm 1.8 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^\circ = 4.0 \pm 1.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2400^\circ\text{K}$$

$$\Delta H_m = 18.0 \text{ kcal gfw}^{-1}$$

$$C_p^\circ = 8.818 + 5.106 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^\circ\text{K} \leq T \leq 2400^\circ\text{K}$$

$$C_p^\circ = 21.072 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 2400^\circ\text{K} \leq T \leq 3500^\circ\text{K}$$

Structure

Face-centered-cubic Cl-type: $a = 4.33 \text{ kX}$.

Heat of Formation

Third Law calculation of Pollock's¹ data yields $-23.8 \pm 1.8 \text{ kcal gfw}^{-1}$.

Heat Capacity and Entropy

The heat-capacity equation of Neely *et al*² has been extrapolated to 2400°K . A constant heat capacity of $21.072 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$ has been used to 3500°K . An entropy value of 4.0 ± 1 is based on Krikorian's³ estimate of ΔF_{298} and ΔH_{298} .

Melting and Vaporization

The melting point of $2400 \pm 30^\circ\text{K}$ is based upon the Brewer *et al*⁴ value of 2373°K and Gaev's⁵ reported decomposition at 2423°K .

References

1. Pollock, B., J. Phys. Chem. **63**, 587 (1959).
2. Neely, J., C. Teeter, and J. Trice, J. Am. Ceram. Soc. **33**, 363 (1950).
3. Krikorian, O., UCRL 2888 (1955).
4. Brewer, L., L. Bromley, P. Gilles, and N. Lofgren, The Chemistry and Metallurgy of Miscellaneous Materials, In: *Thermodynamics*, McGraw-Hill, New York (1950).
5. Gaev, I., AEC-TR-3036, Transl. from Zh. Neorg. Khim. **1**, 196 (1956).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
298.15	± 0.775	± 1.000	± 1.000	± 0.000	± 1.800		
500	± 0.852	± 1.419	± 1.091	± 0.164			
1000	± 1.044	± 2.069	± 1.430	± 0.638			
1500	± 1.235	± 2.528	± 1.723	± 1.208			
2000	± 1.427	± 2.910	± 1.973	± 1.874			
2400	± 1.580	± 3.184	± 2.152	± 2.475			
2400	± 3.000	± 4.684	± 2.152	± 6.075			
2500	± 3.000	± 4.806	± 2.256	± 6.375			
3000	± 3.000	± 5.353	± 2.728	± 7.875			
3500	± 3.000	± 5.815	± 3.137	± 9.375			

TABLE 101

DIMERIC BERYLLIUM OXIDE

IDEAL MOLECULAR GAS

 Be_2O_2

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Be from 0° to 1556°K,
 Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K, Gaseous O_2 , Gaseous Be_2O_2

T, °K	C_p	S_T	$-(F_T - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-3.000	-101.691	-101.691	INFINITE
298.15	10.831	58.562	58.562	0.000	-101.700	-103.188	75.635
300	10.866	58.629	58.562	0.020	-101.707	-103.197	75.175
400	12.712	62.012	59.011	1.200	-102.117	-103.633	56.620
500	14.265	65.022	59.918	2.552	-102.502	-103.965	45.441
600	15.461	67.734	60.998	4.041	-102.857	-104.225	37.962
700	16.356	70.188	62.139	5.634	-103.185	-104.428	32.602
800	17.026	72.418	63.286	7.305	-103.504	-104.584	28.570
900	17.533	74.454	64.416	9.034	-103.825	-104.698	25.423
1000	17.922	76.323	65.514	10.808	-104.157	-104.777	22.898
1100	18.225	78.046	66.576	12.616	-104.514	-104.825	20.826
1200	18.464	79.647	67.599	14.451	-104.895	-104.839	19.093
1300	18.657	81.128	68.584	16.307	-105.306	-104.821	17.621
1400	18.813	82.516	69.530	18.181	-105.748	-104.769	16.354
1500	18.942	83.819	70.439	20.069	-106.226	-104.679	15.251
1556	19.003	84.513	70.932	21.132	-106.512	-104.613	14.693
1556	19.003	84.513	70.932	21.132	-113.580	-104.613	14.693
1600	19.048	85.045	71.314	21.969	-113.735	-104.361	14.254
1700	19.138	86.203	72.156	23.878	-11.095	-103.764	13.339
1800	19.214	87.249	72.967	25.796	-114.462	-103.147	12.523
1900	19.279	88.319	73.749	27.721	-114.837	-102.509	11.791
2000	19.335	89.330	74.504	29.652	-115.222	-101.852	11.129
2100	19.383	90.274	75.232	31.588	-115.618	-101.169	10.528
2200	19.426	91.177	75.937	33.528	-116.025	-100.472	9.981
2300	19.463	92.041	76.618	35.473	-116.444	-99.757	9.479
2400	19.495	92.870	77.278	37.421	-116.874	-99.019	9.016
2500	19.524	93.667	77.918	39.372	-117.319	-98.268	8.590
2600	19.550	94.433	78.539	41.325	-117.776	-97.498	8.195
2700	19.573	95.171	79.141	43.282	-118.245	-96.710	7.828
2767.61	19.587	95.677	79.540	44.613	-118.572	-96.164	7.592
2767.61	19.587	95.677	79.540	44.613	-258.887	-96.164	7.592
2800	19.594	95.884	79.726	45.240	-258.877	-94.280	7.359
2900	19.612	96.572	80.295	47.200	-258.865	-88.401	6.662
3000	19.624	97.237	80.849	49.163	-258.856	-82.518	6.011
3100	19.644	97.881	81.388	51.126	-258.856	-76.637	5.403
3200	19.658	98.505	81.913	53.091	-258.863	-70.762	4.833
3300	19.671	99.110	82.425	55.058	-258.875	-64.889	4.297
3400	19.682	99.697	82.925	57.026	-258.895	-59.010	3.793
3500	19.693	100.268	83.412	58.994	-258.927	-53.123	3.317
3600	19.702	100.823	83.888	60.964	-258.967	-47.250	2.868
3700	19.711	101.363	84.353	62.935	-259.015	-41.364	2.443
3800	19.720	101.888	84.808	64.907	-259.078	-35.485	2.041
3900	19.727	102.401	85.252	66.879	-259.153	-29.593	1.658
4000	19.734	102.900	85.687	68.852	-259.242	-23.708	1.295
4100	19.741	103.388	86.113	70.826	-259.346	-17.818	0.950
4200	19.747	103.864	86.530	72.800	-259.466	-11.921	0.620
4300	19.753	104.328	86.939	74.775	-259.604	-6.029	0.306
4400	19.758	104.782	87.339	76.751	-259.760	-0.126	0.006
4500	19.763	105.227	87.732	78.727	-259.933	5.769	-0.280
4600	19.768	105.661	88.117	80.704	-260.130	11.676	-0.555
4700	19.771	106.086	88.494	82.681	-260.348	17.605	-0.819
4800	19.776	106.503	88.865	84.658	-260.592	23.513	-1.071
4900	19.780	106.910	89.229	86.636	-260.859	29.434	-1.313
5000	19.784	107.310	89.587	88.614	-261.154	35.365	-1.546
5100	19.787	107.702	89.938	90.593	-261.479	41.304	-1.770
5200	19.790	108.086	90.284	92.572	-261.834	46.313	-1.946
5300	19.793	108.463	90.623	94.551	-262.226	53.187	-2.193
5400	19.796	108.833	90.957	96.531	-262.652	59.150	-2.394
5500	19.799	109.196	91.285	98.510	-263.120	65.115	-2.587
5600	19.802	109.553	91.608	100.491	-263.630	71.088	-2.774
5700	19.804	109.904	91.926	102.471	-264.188	77.075	-2.955
5800	19.806	110.256	92.239	104.451	-264.802	83.076	-3.130
5900	19.808	110.607	92.547	106.432	-265.476	89.077	-3.299
6000	19.811	110.920	92.851	108.413	-266.215	95.106	-3.464

15 September 1962

RCF

DIMERIC BERYLLIUM OXIDE (Be_2O_2) (IDEAL MOLECULAR GAS) gfw = 50.026

$$\Delta H^\circ_{f0} = -101.691 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = -107.700 \text{ kcal gfw}^{-1}$$

Point Group = planar

$$S^\circ_{298.15} = 58.562 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 3.000 \text{ Kcal gfw}^{-1}$$

Bond lengths and angles:

Be-O distance = 1.63 Å

Heat of Formation

Third law calculations of the data of Chupka, et al¹ were made.

Heat Capacity and Entropy

Values of C_p° , S_t° , $(F-H^\circ_{298})/T$ and $H-H^\circ_{298}$ given by Hildenbrand² were used.

References

1. Chupka, W., et al J. Chem. Phys. 30, 827 (1959).
2. Hildenbrand, D.L., Aeronutronic Publ. No. C-623, Contract NOrd 17980 (Sept. 1959).

TABLE 102
BERYLLIUM NITRIDE CONDENSED PHASE

Be₃N₂

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid Be from 0° to 1556°K,
Liquid Be from 1556° to 2767°K, Gaseous Be from 2767° to 6000°K, Gaseous N₂,
Solid Be₃N₂ from 0° to 2470°K, Liquid Be₃N₂ from 2470° to 3500°K.

T, °K	C_p	ΔH_f° cal/gfw	ΔG_f° cal/gfw	ΔH_f° cal/gfw	ΔG_f° cal/gfw	ΔH_f° cal/gfw	ΔG_f° cal/gfw	$\log K_p$
0								
298.15	16.498	12.000	12.000	0.000	-132.000	-119.890	87.878	
300	16.580	12.102	12.000	0.031	-132.003	-119.814	87.280	
400	19.875	17.362	12.695	1.867	-132.184	-115.724	63.225	
500	21.884	22.020	14.154	3.958	-132.305	-111.591	48.774	
600	23.477	26.155	15.774	6.228	-132.380	-107.443	39.134	
700	24.849	29.879	17.528	8.646	-132.405	-103.284	32.245	
800	26.104	33.280	19.287	11.194	-132.388	-99.126	27.079	
900	27.291	36.474	21.019	13.864	-132.332	-94.967	23.060	
1000	28.435	39.358	22.707	16.651	-132.236	-90.822	19.848	
1100	29.552	42.121	24.348	19.550	-132.114	-86.691	17.223	
1200	30.650	44.740	25.939	22.561	-131.956	-82.572	15.038	
1300	31.734	47.236	27.482	25.680	-131.763	-78.466	13.191	
1400	32.809	49.627	28.979	28.907	-131.535	-74.376	11.610	
1500	33.877	51.927	30.433	32.242	-131.273	-70.300	10.242	
1556	34.472	53.180	31.229	34.155	-131.115	-68.028	9.554	
1556	34.469	53.180	31.229	34.155	-141.675	-68.028	9.554	
1600	34.936	54.147	31.846	35.682	-141.425	-65.945	9.007	
1700	35.994	56.297	33.221	39.229	-140.799	-61.245	7.873	
1800	37.049	58.384	34.561	42.881	-140.090	-56.584	6.870	
1900	38.101	60.415	35.869	46.639	-139.295	-51.966	5.977	
2000	39.151	62.396	37.146	50.501	-138.414	-47.392	5.179	
2100	40.199	64.332	38.395	54.468	-137.447	-42.856	4.460	
2200	41.246	66.226	39.617	58.541	-136.393	-38.374	3.812	
2300	42.291	68.083	40.814	62.717	-135.258	-33.942	3.225	
2400	43.336	69.905	41.989	66.999	-134.046	-29.560	2.692	
2470	44.067	71.161	42.798	70.058	-133.129	-26.537	2.348	
2470	44.067	83.661	42.798	100.933	-102.254	-26.537	2.348	
2500	44.067	84.193	43.291	102.255	-101.851	-25.605	2.238	
2600	44.067	85.921	44.898	106.662	-100.537	-22.583	1.898	
2700	44.067	87.584	46.448	111.068	-99.242	-19.610	1.587	
2767.61	44.067	88.674	47.466	114.048	-98.383	-17.627	1.392	
2767.61	44.067	88.674	47.466	114.048	-308.890	-17.627	1.392	
2800	44.067	89.187	47.946	115.475	-308.229	-14.249	1.112	
2900	44.067	90.733	49.395	119.882	-306.205	-3.782	0.285	
3000	44.067	92.227	50.798	124.288	-304.186	6.618	-0.482	
3100	44.067	93.672	52.153	128.695	-302.173	16.946	-1.195	
3200	44.067	95.071	53.477	133.102	-300.169	27.206	-1.858	
3300	44.067	96.427	54.758	137.509	-298.141	37.398	-2.477	
3400	44.067	97.743	56.003	141.915	-296.152	47.540	-3.056	
3500	44.067	99.020	57.214	146.322	-294.205	57.626	-3.598	

15 September 1963

RED

BERYLLIUM NITRIDE (Be_3N_2) (CONDENSED PHASE) gfw = 55.055

$$\begin{aligned}\Delta H_{298.15}^\circ &= -132 \pm 3 \text{ kcal gfw}^{-1} & S_{298.15}^\circ &= 12 \pm 2 \text{ cal deg}^{-1} \text{ gfw}^{-1} \\ T_m &= 2470^\circ\text{K} & \Delta H_m &= 30.875 \pm 3.7 \text{ kcal gfw}^{-1} \\ C_p^\circ &= 18.510 + 10.377 \times 10^{-3} T - 45.390 \times 10^{-4} T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1} \\ & & 298^\circ\text{K} \leq T \leq 2470^\circ\text{K} \\ C_p^\circ &= 44.06 \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 2470^\circ\text{K} \leq T \leq 3500^\circ\text{K}\end{aligned}$$

Structure

Body centered anti- Mn_2O_3 (D5) structure: $a = 8.13 \pm 0.10 \text{ kX}$.

Heat of Formation

Value obtained from NBS Report 6645¹ based on Neumann et al² direct nitriding.

Heat Capacity and Entropy

Low-temperature data was estimated by Kelley.³ High-temperature data of Sato⁴ and Kelley⁵ was recalculated and extrapolated. Liquid heat capacity assumed equal to that of solid at m. p. and constant to 3500°K.

Melting and Vaporization

Melting point assumed at 2470°K based on Brewer⁶ et al.

References

1. Beckett, C. W., et al, Prelim. Report, Selected Light Element Compds, NBSR 6645 (1960).
2. Neumann, B., C. Kroger, & H. Haebler, Z. Anorg. U. Allgem. Chim. 204,81 (1932).
3. Kelley, K. K., Bur. of Mines Bulletin 407 (1937).
4. Sato, S., Sci. Papers Inst. Phys. Chem. Research (Tokyo) 34,888 (1938).
5. Kelley, K. K., U. S. Bureau of Mines Report 584 (1960).
6. Brewer, L., L. Bromley, P. Gilles, & N. Lofgren., The Chem. & Met. of Miscellaneous Materials., McGraw-Hill (1950).

BERYLLIUM NITRIDE (Be_3N_2) (CONDENSED PHASE) GFW = 55.055

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$(F_T - H_{298}^\circ) T$	$H_T - H_{298}^\circ$	ΔH_f°	ΔG_f°	log K _p
298.15	± 0.826	± 2.000	± 2.000	± 0.000	± 3.000		
500	± 1.094	± 2.501	± 2.105	± 0.198			
1000	± 1.421	± 3.368	± 2.535	± 0.832			
1500	± 1.693	± 3.996	± 2.922	± 1.612			
1556	± 1.723	± 4.059	± 2.961	± 1.707			
1556	± 2.757	± 4.059	± 2.961	± 1.707			
2000	± 3.132	± 4.796	± 3.289	± 3.015			
2470	± 3.525	± 5.497	± 3.643	± 4.580			
2470	± 5.000	± 6.995	± 3.643	± 8.280			
2500	± 5.000	± 7.056	± 3.684	± 8.430			
3000	± 5.000	± 7.967	± 4.324	± 10.930			
3500	± 5.000	± 8.738	± 4.901	± 13.430			

TABLE 103

IPIMERIC BERYLLIUM OXIDE IDEAL MOLECULAR GAS

 Be_3O_3 Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Be from 1° to 1556°K, Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K, Gaseous O_2 , Gaseous Be_3O_3

T, °K	$\int_p^1 \frac{C_p}{T^2} dT$	$\int_p^1 \frac{C_p}{T} dT$	$\int_p^1 \frac{C_p}{T^2} dT$	$\int_p^1 \frac{C_p}{T} dT$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-3.750	-251.936	-251.936	INFINITE
298.15	15.367	64.254	64.254	0.000	-252.700	-247.899	181.706
300	15.443	64.349	64.254	0.078	-252.713	-247.868	180.563
400	19.195	69.325	64.907	1.767	-253.359	-246.156	134.487
500	22.101	73.936	66.258	3.838	-253.893	-244.288	106.773
600	24.248	78.165	67.895	6.161	-254.336	-242.327	88.263
700	25.820	82.028	69.645	8.669	-254.710	-240.296	75.020
800	26.981	85.555	71.415	11.312	-255.052	-238.215	65.074
900	27.850	88.786	73.168	14.056	-255.383	-236.086	57.327
1000	28.513	91.756	74.880	16.875	-255.723	-233.925	51.122
1100	29.028	94.499	76.540	19.753	-256.092	-231.731	46.039
1200	29.434	97.042	78.144	22.677	-256.492	-229.503	41.796
1300	29.758	99.412	79.690	25.637	-256.933	-227.240	38.201
1400	30.022	101.627	81.179	28.627	-257.417	-224.941	35.113
1500	30.238	103.706	82.612	31.640	-257.953	-222.599	32.431
1556	30.341	104.814	83.387	33.341	-258.275	-221.264	31.076
1556	30.341	104.814	83.387	33.341	-258.877	-221.264	31.076
1600	30.418	105.663	83.992	34.673	-259.033	-219.925	30.039
1700	30.568	107.512	85.322	37.723	-26.387	-216.845	27.876
1800	30.696	109.263	86.604	40.786	-269.751	-213.747	25.951
1900	30.805	110.926	87.840	43.862	-270.125	-210.625	24.226
2000	30.898	112.508	89.035	46.947	-270.514	-207.486	22.672
2100	30.979	114.018	90.189	50.041	-270.918	-204.319	21.263
2200	31.050	115.461	91.305	53.143	-271.337	-201.138	19.980
2300	31.112	116.842	92.385	56.251	-271.775	-197.938	18.808
2400	31.167	118.168	93.432	59.365	-272.228	-194.715	17.730
2500	31.215	119.441	94.447	62.484	-272.703	-191.476	16.738
2600	31.258	120.666	95.432	65.608	-273.194	-188.219	15.820
2700	31.296	121.847	96.389	68.736	-273.705	-184.945	14.970
2767.61	31.321	122.624	97.022	70.865	-274.063	-182.703	14.425
2767.61	31.321	122.624	97.022	70.865	-484.528	-182.703	14.425
2800	31.331	122.985	97.318	71.867	-484.458	-179.211	13.987
2900	31.362	124.085	98.223	75.002	-484.246	-168.314	12.684
3000	31.390	125.149	99.102	78.139	-484.040	-157.413	11.467
3100	31.415	126.174	99.959	81.280	-483.843	-146.523	10.329
3200	31.438	127.177	100.794	84.422	-483.659	-135.652	9.264
3300	31.460	128.144	101.609	87.567	-483.483	-124.789	8.264
3400	31.479	129.084	102.403	90.714	-483.318	-113.917	7.322
3500	31.496	129.997	103.178	93.864	-483.159	-103.045	6.434
3600	31.513	130.884	103.936	97.014	-483.033	-92.199	5.597
3700	31.528	131.748	104.676	100.166	-482.909	-81.338	4.804
3800	31.541	132.589	105.399	103.319	-482.809	-70.488	4.054
3900	31.554	133.408	106.107	106.474	-482.724	-59.632	3.342
4000	31.566	134.207	106.800	109.630	-482.661	-48.790	2.666
4100	31.577	134.987	107.478	112.787	-482.621	-37.942	2.022
4200	31.587	135.748	108.142	115.946	-482.603	-27.089	1.410
4300	31.597	136.491	108.792	119.105	-482.613	-16.243	0.826
4400	31.606	137.218	109.430	122.265	-482.652	-5.394	0.268
4500	31.614	137.928	110.056	125.426	-482.714	5.442	-0.264
4600	31.622	138.623	110.669	128.588	-482.813	16.294	-0.774
4700	31.629	139.303	111.271	131.751	-482.943	27.166	-1.263
4800	31.636	139.969	111.862	134.914	-483.111	38.010	-1.731
4900	31.642	140.622	112.442	138.078	-483.314	48.869	-2.180
5000	31.648	141.261	113.012	141.242	-483.560	59.740	-2.611
5100	31.654	141.888	113.572	144.407	-483.851	70.614	-3.026
5200	31.659	142.502	114.123	147.573	-484.186	80.095	-3.366
5300	31.664	143.106	114.664	150.739	-484.577	92.164	-3.809
5400	31.669	143.697	115.196	153.906	-485.018	103.268	-4.179
5500	31.674	144.279	115.720	157.073	-485.522	114.164	-4.536
5600	31.678	144.849	116.235	160.241	-486.091	125.073	-4.881
5700	31.682	145.410	116.742	163.409	-486.730	136.000	-5.214
5800	31.686	145.961	117.241	166.578	-487.452	146.946	-5.537
5900	31.689	146.503	117.732	169.746	-488.266	157.887	-5.848
6000	31.692	147.036	118.216	172.916	-489.177	168.877	-6.151

15 September 1962

RCF

TRIMERIC BERYLLIUM OXIDE (Be_3O_3) (IDEAL MOLECULAR GAS) gfw = 75.039

$$\Delta H^\circ_{f0} = -251.936 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = -252.700 \pm \text{kcal gfw}^{-1}$$

Point Group = planar

$$S^\circ_{298.15} = 64.254 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 3.750 \text{ Kcal gfw}^{-1}$$

Bond lengths and angles:

Be-O distance = 1.63 Å

Heat of Formation

Third law calculations of data by Chupka, et al¹ were made.

Heat Capacity and Entropy

Values given by Hildenbrand² were used.

References

1. Chupka, W., et al, J. Chem. Phys. 30, 827 (1959).
2. Hildenbrand, D. L., Aeronutronic Publ. No. C-623, Contract NOrd 17980 (1959).

TABLE 104

TETRAMERIC BERYLLIUM OXIDE IDEAL MOLECULAR GAS

Be₄O₄Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Be from 0° to 1556°K, Liquid Be from 1556° to 2768°K, Gaseous Be from 2768° to 6000°K, Gaseous O₂, Gaseous Be₄O₄

T, °K	C_p	C_p	C_p	C_p	C_p	C_p	Log Kp
0	0.000	0.000	INFINITE	-4.500	-376.082	-376.082	INFINITE
298.15	21.520	72.309	72.309	0.000	-377.600	-467.215	269.163
300	21.625	72.442	72.310	0.039	-377.615	-467.149	267.455
400	26.751	79.393	73.222	2.468	-378.366	-463.546	198.623
500	30.685	85.507	75.107	5.349	-378.959	-459.766	157.246
600	33.581	91.671	77.387	8.570	-379.426	-455.885	129.625
700	36.696	97.015	79.815	12.040	-379.798	-451.932	109.873
800	37.257	101.889	82.274	15.691	-380.127	-447.930	95.045
900	38.425	106.348	84.705	19.478	-380.440	-443.882	83.502
1000	39.316	110.444	87.077	23.367	-380.763	-439.803	74.260
1100	40.006	114.275	89.375	27.335	-381.125	-435.696	66.693
1200	40.551	117.730	91.594	31.364	-381.528	-431.554	60.381
1300	40.986	120.994	93.731	35.441	-381.985	-427.375	55.034
1400	41.340	124.045	95.789	39.558	-382.500	-423.158	50.445
1500	41.630	126.907	97.769	43.707	-383.083	-418.895	46.461
1556	41.765	128.430	98.839	46.044	-383.444	-416.479	44.449
1556	41.765	128.430	98.839	46.044	-397.580	-416.479	44.449
1600	41.871	129.602	99.675	47.883	-397.725	-414.197	42.915
1700	42.073	132.147	101.511	52.080	-398.066	-408.966	39.718
1800	42.244	134.557	103.281	56.296	-398.420	-403.719	36.875
1900	42.390	136.845	104.987	60.528	-398.788	-398.448	34.328
2000	42.516	139.022	106.635	64.774	-399.174	-393.158	32.033
2100	42.625	141.099	108.227	69.031	-399.581	-287.840	29.954
2200	42.719	143.085	109.767	73.298	-400.008	-282.509	28.063
2300	42.803	144.985	111.257	77.575	-400.459	-277.161	26.335
2400	42.876	146.809	112.701	81.859	-400.931	-271.786	24.748
2500	42.941	148.560	114.100	86.150	-401.432	-266.395	23.287
2600	42.998	150.246	115.458	90.447	-401.955	-260.985	21.937
2700	43.050	151.869	116.777	94.749	-402.505	-255.557	20.685
2767.61	43.081	152.938	117.650	97.678	-402.892	-251.850	19.884
2767.61	43.081	152.938	117.650	97.678	-683.512	-251.850	19.884
2800	43.096	153.436	118.058	99.056	-683.378	-246.857	19.267
2900	43.138	154.945	119.305	103.368	-682.962	-231.275	17.428
3000	43.175	156.412	120.517	107.684	-682.554	-215.693	15.712
3100	43.209	157.828	121.698	112.003	-682.161	-200.131	14.109
3200	43.240	159.201	122.849	116.326	-681.782	-184.598	12.607
3300	43.269	160.532	123.970	120.651	-681.415	-169.073	11.197
3400	43.294	161.824	125.060	124.979	-681.063	-153.550	9.870
3500	43.318	163.079	126.135	129.310	-680.732	-138.028	8.618
3600	43.340	164.300	127.177	133.643	-680.419	-122.544	7.439
3700	43.360	165.487	128.196	137.978	-680.122	-107.041	6.322
3800	43.378	166.644	129.193	142.315	-679.855	-91.563	5.266
3900	43.395	167.771	130.167	146.654	-679.610	-76.072	4.263
4000	43.411	168.820	131.121	150.994	-679.394	-60.604	3.311
4100	43.426	169.792	132.055	155.336	-679.208	-45.135	2.406
4200	43.440	170.989	132.970	159.680	-679.052	-29.664	1.543
4300	43.453	172.011	133.866	164.024	-678.934	-14.207	0.722
4400	43.464	173.010	134.744	168.370	-678.852	1.258	-0.062
4500	43.476	173.987	135.605	172.717	-678.803	16.704	-0.811
4600	43.486	174.943	136.450	177.065	-678.803	32.159	-1.528
4700	43.496	175.878	137.279	181.415	-678.843	47.642	-2.215
4800	43.504	176.794	138.093	185.765	-678.935	63.083	-2.872
4900	43.514	177.691	138.892	190.116	-679.074	78.541	-3.503
5000	43.522	178.570	139.677	194.467	-679.261	94.015	-4.109
5100	43.529	179.432	140.448	198.820	-679.524	109.491	-4.692
5200	43.536	180.278	141.206	203.173	-679.839	123.108	-5.174
5300	43.543	181.107	141.951	207.527	-680.227	140.438	-5.791
5400	43.550	181.921	142.683	211.882	-680.684	155.947	-6.311
5500	43.557	182.720	143.404	216.237	-681.223	171.443	-6.812
5600	43.562	183.505	144.113	220.593	-681.849	186.953	-7.296
5700	43.567	184.276	144.811	224.950	-682.568	202.483	-7.763
5800	43.572	185.034	145.498	229.307	-683.399	218.037	-8.215
5900	43.577	185.779	146.174	233.664	-684.352	233.581	-8.652
6000	43.582	186.511	146.841	238.022	-685.436	249.178	-9.076

15 September 1962

NCE

TETRAMERIC BERYLLIUM (IDEAL MOLECULAR GAS) gfw = 100.052
OXIDE (Be₄O₄)

$$\Delta H^\circ_{f0} = -376.082 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = -377.600 \pm 4.000 \text{ Kcal gfw}^{-1}$$

Point Group = planar

$$S^\circ_{298.15} = 72.309 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 4.500 \text{ Kcal gfw}^{-1}$$

Bond lengths and angles:

Be-O distance = 1.63 Å

Heat of Formation

Based on data of Chupka et al¹.

Heat Capacity and Entropy

Values given by Hildenbrand² were used.

References

1. Chupka, W., et al, J. Chem. Phys. 30, 827 (1959).
2. Hildenbrand, D. L., Aeronutronic Publ. No. C-623, Contract NOrd 17980 (1959).

TABLE 105

PENTAMERIC BERYLLIUM OXIDE IDEAL MOLECULAR GAS

Be₅O₅

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p Solid Be from 0° to 1556°K.
 Liquid Be from 1556° to 2768°K. Gaseous Be from 2768° to 6000°K. Gaseous O₂. Gaseous Be₅O₅

T, °K	C_p°	S_T°	$\frac{\text{cal/}^\circ\text{K gfw}}{-(F_T^\circ - H_{298}^\circ)/T}$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-5.250	-500.227	-500.227	INFINITE
298.15	27.673	79.700	79.700	0.000	-502.500	-486.332	356.474
300	27.806	79.871	79.701	0.051	-502.517	-486.231	354.202
400	34.307	88.798	80.873	3.169	-503.374	-480.671	262.614
500	39.269	97.013	83.292	6.860	-504.025	-474.911	207.573
600	42.913	104.513	86.214	10.979	-504.516	-469.045	170.841
700	45.573	111.338	89.323	15.410	-504.888	-463.103	144.580
800	47.532	117.558	92.469	20.070	-505.202	-457.113	124.872
900	49.000	123.245	95.578	24.901	-505.497	-451.079	109.532
1000	50.118	128.469	98.609	29.859	-505.804	-445.017	97.254
1100	50.985	133.288	101.546	34.916	-506.159	-438.929	87.203
1200	51.668	137.754	104.379	40.050	-506.565	-432.806	78.821
1300	52.215	141.912	107.108	45.245	-507.038	-426.646	71.722
1400	52.658	145.799	109.735	50.489	-507.584	-420.446	65.631
1500	52.022	149.445	112.262	55.774	-508.214	-414.194	60.345
1556	53.196	151.383	113.626	58.750	-508.610	-410.659	57.677
1556	53.196	151.383	113.626	58.750	-526.280	-410.659	57.677
1600	53.325	152.877	114.694	61.092	-526.418	-407.406	55.646
1700	53.578	156.117	117.036	66.437	-526.445	-399.958	51.416
1800	53.793	159.186	119.293	71.806	-527.089	-392.494	47.653
1900	53.976	162.099	121.470	77.195	-527.450	-385.009	44.284
2000	54.134	164.872	123.572	82.601	-527.834	-377.504	41.250
2100	54.270	167.517	125.602	88.021	-528.244	-369.968	38.501
2200	54.389	170.044	127.565	93.454	-528.679	-362.421	36.001
2300	54.493	172.464	129.465	98.898	-529.145	-354.857	33.718
2400	54.585	174.785	131.305	104.353	-529.635	-347.262	31.621
2500	54.666	177.015	133.089	109.815	-530.162	-339.654	29.691
2600	54.738	179.161	134.820	115.286	-530.717	-332.025	27.908
2700	54.803	181.228	136.501	120.763	-531.305	-324.377	26.255
2767.61	54.843	182.588	137.613	124.491	-531.722	-319.156	25.198
2767.61	54.843	182.588	137.613	124.491	-531.722	-319.156	25.198
2800	54.861	183.222	138.134	126.246	-532.297	-312.643	24.402
2900	54.913	185.144	139.722	131.735	-533.678	-292.307	22.028
3000	54.960	187.011	141.268	137.229	-535.069	-271.987	19.813
3100	55.003	188.814	142.773	142.727	-536.478	-251.681	17.743
3200	55.042	190.560	144.239	148.229	-537.906	-231.417	15.804
3300	55.078	192.255	145.668	153.735	-539.348	-211.169	13.984
3400	55.110	193.900	147.063	159.245	-540.807	-190.926	12.272
3500	55.140	195.497	148.424	164.757	-542.281	-170.688	10.658
3600	55.167	197.051	149.753	170.273	-543.769	-150.494	9.136
3700	55.192	198.563	151.052	175.791	-545.269	-130.287	7.695
3800	55.215	200.035	152.322	181.311	-546.782	-110.110	6.332
3900	55.237	201.470	153.564	186.834	-548.307	-89.925	5.039
4000	55.257	202.864	154.774	192.358	-549.844	-69.766	3.812
4100	55.275	204.213	155.968	197.885	-551.395	-49.606	2.644
4200	55.292	205.565	157.134	203.414	-552.950	-29.450	1.532
4300	55.308	206.867	158.275	208.944	-554.519	-9.312	0.473
4400	55.323	208.138	159.394	214.475	-556.093	10.830	-0.538
4500	55.337	209.382	160.491	220.008	-557.672	30.948	-1.503
4600	55.350	210.598	161.567	225.543	-559.257	51.078	-2.427
4700	55.363	211.784	162.623	231.078	-560.847	71.238	-3.312
4800	55.374	212.954	163.660	236.615	-562.442	91.344	-4.159
4900	55.385	214.096	164.677	242.153	-564.042	111.472	-4.972
5000	55.395	215.215	165.677	247.692	-565.647	131.615	-5.753
5100	55.405	216.312	166.654	253.232	-567.257	151.759	-6.503
5200	55.414	217.388	167.624	258.773	-568.872	169.579	-7.127
5300	55.422	218.444	168.573	264.315	-570.492	187.036	-7.918
5400	55.430	219.480	169.506	269.858	-572.117	204.217	-8.588
5500	55.438	220.497	170.424	275.401	-573.747	221.374	-9.233
5600	55.445	221.496	171.327	280.945	-575.382	238.551	-9.856
5700	55.452	222.478	172.216	286.490	-577.022	255.751	-10.447
5800	55.458	223.442	173.091	292.036	-578.667	272.979	-11.039
5900	55.465	224.390	173.952	297.582	-580.317	290.239	-11.601
6000	55.470	225.322	174.801	303.129	-581.972	307.524	-12.146

15 September 1962

RCF

PENTAMERIC BERYLLIUM OXIDE (Be_5O_5)(IDEAL MOLECULAR GAS) gfw = 125.065

$$\Delta H^\circ_{f0} = -500.227 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = -502. \text{ Kcal gfw}^{-1}$$

Point Group = planar

$$S^\circ_{298.15} = 79.700 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 5.250 \text{ Kcal gfw}^{-1}$$

Bond lengths and angles:

Be-O distance = 1.63 Å .

Heat of Formation

Based on data of Chupka et al.¹

Heat Capacity and Entropy

Values given by Hildenbrand² were used.

References

1. Chupka, W., et al., J. Chem. Phys. 30, 827 (1959).
- 2 Hildenbrand, D. L., Aeronutronic Publ. No. G-623, Contract NOrd 17980 (1959).

TABLE 106

HEXAMERIC BERYLLIUM OXIDE

IDEAL MOLECULAR GAS

 Be_6O_6

Reference State for Calculating ΔH_f° , ΔF_f° and $\log K_p$: Solid Be from 0° to 1556°K.
 Liquid Be from 1556° to 2768°K. Gaseous Be from 2768° to 6000°K. Gaseous O_2 , Gaseous Be_6O_6

T, °K	C_p	S_T°	$-RT \ln (H_{298}^\circ/T)$	$H_1 - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-6.000	-629.773	-629.773	INFINITE
298.15	33.825	86.687	86.687	0.000	-632.800	-610.729	447.655
300	33.988	86.896	86.896	0.062	-632.819	-610.591	444.794
400	41.864	97.798	86.121	3.870	-633.781	-603.035	329.467
500	47.853	107.817	91.073	8.371	-634.491	-595.255	260.173
600	52.246	116.951	94.637	13.388	-635.006	-587.362	213.936
700	55.449	125.258	98.427	18.781	-635.376	-579.391	180.885
800	57.808	132.824	102.261	24.450	-635.677	-571.374	156.085
900	59.574	139.740	106.047	30.323	-635.954	-563.313	136.784
1000	60.920	146.089	109.738	36.351	-636.244	-555.227	121.339
1100	61.963	151.946	113.312	42.497	-636.593	-547.118	108.697
1200	62.785	157.375	116.761	48.736	-637.002	-538.974	98.156
1300	63.443	162.427	120.082	55.049	-637.490	-530.793	89.230
1400	63.976	167.149	123.277	61.421	-638.066	-522.568	81.573
1500	64.414	171.578	126.351	67.841	-638.744	-514.288	74.928
1556	64.622	173.932	128.009	71.456	-639.176	-509.610	71.574
1556	64.622	173.932	128.009	71.456	-660.296	-509.610	71.574
1600	64.778	175.747	129.309	74.301	-660.427	-505.370	69.027
1700	65.083	179.684	132.158	80.795	-660.740	-495.664	63.719
1800	65.361	183.417	134.902	87.316	-661.074	-485.943	58.999
1900	65.562	186.951	137.549	93.862	-661.428	-476.202	54.773
2000	65.751	190.318	140.104	100.428	-661.810	-466.440	50.968
2100	65.915	193.520	142.573	107.011	-662.223	-456.648	47.522
2200	66.058	196.670	144.959	113.610	-662.665	-446.843	44.388
2300	66.183	199.539	147.269	120.222	-663.145	-437.024	41.525
2400	66.294	202.359	149.506	126.846	-663.655	-427.170	38.897
2500	66.392	205.067	151.674	133.481	-664.208	-417.303	36.479
2600	66.479	207.673	153.778	140.124	-664.795	-407.414	34.245
2700	66.556	210.183	155.821	146.776	-665.421	-397.506	32.174
2767.61	66.604	211.834	157.172	151.305	-665.866	-390.744	30.850
2767.61	66.604	211.834	157.172	151.305	-1086.880	-390.744	30.850
2800	66.626	212.605	157.806	153.436	-1086.615	-382.698	29.870
2900	66.689	214.944	159.736	160.101	-1085.794	-357.570	26.946
3000	66.746	217.206	161.615	166.773	-1084.984	-332.458	24.218
3100	66.797	219.395	163.443	173.450	-1084.196	-307.374	21.669
3200	66.844	221.517	165.225	180.133	-1083.429	-282.342	19.282
3300	66.887	223.574	166.962	186.819	-1082.680	-257.333	17.042
3400	66.925	225.572	168.657	193.510	-1081.953	-232.328	14.933
3500	66.961	227.512	170.311	200.204	-1081.259	-207.333	12.946
3600	66.994	229.399	171.926	206.902	-1080.591	-182.393	11.072
3700	67.024	231.235	173.504	213.603	-1079.947	-157.439	9.299
3800	67.052	233.023	175.047	220.307	-1079.348	-132.522	7.621
3900	67.078	234.765	176.556	227.014	-1078.782	-107.599	6.029
4000	67.102	236.463	178.033	233.723	-1078.259	-82.712	4.519
4100	67.124	238.121	179.478	240.434	-1077.782	-57.824	3.082
4200	67.145	239.738	180.894	247.147	-1077.351	-32.939	1.714
4300	67.164	241.319	182.281	253.863	-1076.974	-8.083	0.411
4400	67.182	242.863	183.640	260.580	-1076.653	16.781	-0.833
4500	67.199	244.373	184.973	267.299	-1076.381	41.610	-2.021
4600	67.214	245.850	186.280	274.020	-1076.182	66.455	-3.157
4700	67.224	247.296	187.563	280.742	-1076.045	91.334	-4.247
4800	67.243	248.711	188.822	287.466	-1075.984	116.149	-5.288
4900	67.256	250.098	190.059	294.191	-1075.994	140.979	-6.288
5000	67.268	251.457	191.273	300.917	-1076.087	165.835	-7.248
5100	67.280	252.789	192.466	307.645	-1076.271	190.687	-8.171
5200	67.291	254.096	193.639	314.373	-1076.545	212.746	-8.941
5300	67.301	255.377	194.792	321.103	-1076.928	240.370	-9.911
5400	67.311	256.636	195.926	327.834	-1077.415	265.252	-10.735
5500	67.320	257.871	197.041	334.565	-1078.025	290.122	-11.528
5600	67.329	259.084	198.138	341.298	-1078.765	315.006	-12.293
5700	67.337	260.276	199.219	348.031	-1079.646	339.916	-13.032
5800	67.345	261.447	200.280	354.765	-1080.694	364.864	-13.748
5900	67.352	262.598	201.327	361.500	-1081.924	389.782	-14.438
6000	67.359	263.730	202.357	368.236	-1083.351	414.794	-15.108

15 September 1962

RCF

HEXAMERIC BERYLLIUM OXIDE (Be_6O_6) (IDEAL MOLECULAR GAS) gfw=150.078

$$\Delta H^\circ_{f0} = -629.773 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = -632.800 \pm 40.000 \text{ Kcal gfw}^{-1}$$

Point Group = planar

$$S^\circ_{298.15} = 86.687 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 6.000 \text{ Kcal gfw}^{-1}$$

Bond lengths and angles:

Be-O distance = 1.63 Å

Heat of Formation

Based on data of Chupka et al¹.

Heat Capacity and Entropy

Values given by Hildenbrand² were used.

References

1. Chupka, W., et al, J. Chem. Phys. 30, 827 (1959).
2. Hildenbrand, D. L., Aeronutronic Publ. No. C-623, Contract NOrd 17980 (1959).

TABLE 107

CARBON

REFERENCE STATE

C

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$
Solid Graphite from 0°K to 6000°K

T, °K	C_P	S_T	$(F_T - H_{298})/T$	$(H_T - H_{298})$	ΔH_f	ΔF_f	$\log K_p$
0	0.000	0.000	INFINITE	0.252			
298.15	2.038	1.359	1.359	0.000			
300	2.054	1.372	1.359	0.004			
400	2.851	2.075	1.450	0.250			
500	3.496	2.784	1.646	0.569			
600	4.038	3.471	1.893	0.947			
700	4.440	4.126	2.166	1.372			
800	4.740	4.739	2.449	1.831			
900	4.970	5.311	2.736	2.318			
1000	5.149	5.844	3.020	2.824			
1100	5.304	6.342	3.300	3.347			
1200	5.430	6.809	3.573	3.883			
1300	5.527	7.248	3.839	4.432			
1400	5.605	7.661	4.098	4.988			
1500	5.669	8.050	4.348	5.552			
1600	5.721	8.417	4.591	6.122			
1700	5.765	8.765	4.827	6.696			
1800	5.803	9.096	5.055	7.275			
1900	5.836	9.411	5.276	7.857			
2000	5.865	9.711	5.490	8.442			
2100	5.891	9.998	5.698	9.029			
2200	5.914	10.272	5.900	9.620			
2300	5.936	10.536	6.095	10.212			
2400	5.956	10.789	6.286	10.807			
2500	5.974	11.032	6.471	11.403			
2600	5.992	11.267	6.651	12.002			
2700	6.009	11.492	6.826	12.602			
2800	6.026	11.712	6.997	13.203			
2900	6.042	11.924	7.163	13.807			
3000	6.057	12.129	7.325	14.412			
3100	6.073	12.328	7.483	15.018			
3200	6.088	12.521	7.638	15.626			
3300	6.103	12.708	7.788	16.236			
3400	6.117	12.891	7.936	16.847			
3500	6.134	13.068	8.080	17.460			
3600	6.150	13.241	8.221	18.074			
3700	6.165	13.410	8.35	18.690			
3800	6.181	13.575	8.494	19.307			
3900	6.197	13.736	8.626	19.926			
4000	6.213	13.893	8.755	20.546			
4100	6.230	14.046	8.883	21.168			
4200	6.247	14.197	9.008	21.792			
4300	6.264	14.344	9.130	22.418			
4400	6.281	14.488	9.250	23.045			
4500	6.299	14.629	9.368	23.674			
4600	6.317	14.766	9.484	24.305			
4700	6.335	14.904	9.598	24.937			
4800	6.354	15.038	9.710	25.572			
4900	6.372	15.169	9.820	26.208			
5000	6.392	15.298	9.928	26.846			
5100	6.412	15.424	10.035	27.487			
5200	6.432	15.549	10.140	28.129			
5300	6.452	15.672	10.243	28.773			
5400	6.473	15.793	10.34	29.419			
5500	6.494	15.912	10.445	30.068			
5600	6.516	16.029	10.543	30.718			
5700	6.538	16.144	10.641	31.371			
5800	6.560	16.258	10.737	32.026			
5900	6.583	16.371	10.831	32.683			
6000	6.606	16.481	10.924	33.342			

15 September 1962

CHW

CARBON (C)

(REFERENCE STATE)

gfw = 12.011

0°K to 6000 °K Crystal

$$\Delta H^{\circ}_{f0} = 0$$

$$\Delta H^{\circ}_{f298.15} = 0$$

$$\Delta H^{\circ}_{s298.15} = 170.890 \text{ Kcal gfw}^{-1}$$

$$S^{\circ}_{298.15} = 1.359 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^{\circ}_{298.15} - H^{\circ}_0 = 0.252 \text{ Kcal gfw}^{-1}$$

Structure

The graphite structure is used as the reference state.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Data from JANAF tables were used in this table.

Reference

1. JANAF Thermochemical Tables, Dow Chemical Co.(31 December 1960).

TABLE 108

IDEAL MONATOMIC GAS

C

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p
Solid Graphite from 0° to 6000°K

T, °K	$\left(\frac{H_T}{T} - \frac{H_{298}}{298} \right)$ cal./°K gfw	$\left(H_T - H_{298} \right)/T$ cal./gfw	$\left(\frac{H_T}{T} - \frac{H_{298}}{298} \right)$ Kcal/gfw	ΔH_f° Kcal/gfw	ΔF_f° Kcal/gfw	Log K_p
0	0.000	0.000	INFINITE	-1.562	169.580	169.580
298.15	4.981	37.761	37.761	0.000	170.890	160.037
300	4.981	37.792	37.761	0.009	170.895	159.969
400	4.975	39.224	37.957	0.507	171.147	156.287
500	4.973	40.334	38.325	1.004	171.325	152.550
600	4.971	41.240	38.738	1.502	171.445	148.783
700	4.970	42.007	39.152	1.999	171.517	145.000
800	4.970	42.670	39.551	2.496	171.555	141.209
900	4.970	43.256	39.931	2.993	171.565	137.415
1000	4.969	43.779	40.290	3.490	171.556	133.620
1100	4.969	44.253	40.629	3.986	171.529	129.828
1200	4.970	44.685	40.949	4.483	171.490	126.039
1300	4.971	45.083	41.252	4.980	171.438	122.253
1400	4.972	45.452	41.539	5.478	171.380	118.473
1500	4.975	45.795	41.811	5.975	171.313	114.695
1600	4.978	46.116	42.071	6.473	171.241	110.923
1700	4.984	46.418	42.317	6.971	171.165	107.156
1800	4.990	46.703	42.553	7.469	171.084	103.393
1900	4.998	46.973	42.779	7.969	171.002	99.653
2000	5.008	47.229	42.995	8.469	170.917	95.880
2100	5.019	47.474	43.202	8.970	170.831	92.131
2200	5.032	47.708	43.402	9.473	170.743	88.386
2300	5.046	47.932	43.594	9.977	170.655	84.642
2400	5.061	48.147	43.779	10.482	170.565	80.906
2500	5.077	48.354	43.958	10.989	170.476	77.172
2600	5.094	48.553	44.131	11.497	170.385	73.442
2700	5.112	48.746	44.298	12.008	170.296	69.714
2800	5.130	48.922	44.461	12.520	170.207	65.992
2900	5.149	49.092	44.618	13.034	170.117	62.271
3000	5.168	49.287	44.771	13.550	170.028	58.553
3100	5.187	49.457	44.919	14.067	169.939	54.838
3200	5.206	49.622	45.064	14.587	169.851	51.128
3300	5.224	49.782	45.204	15.108	169.762	47.417
3400	5.243	49.939	45.341	15.632	169.675	43.713
3500	5.261	50.091	45.475	16.157	169.587	40.009
3600	5.279	50.239	45.605	16.684	169.500	36.308
3700	5.296	50.384	45.732	17.213	169.413	32.609
3800	5.313	50.526	45.856	17.743	169.326	28.913
3900	5.329	50.664	45.978	18.275	169.239	25.217
4000	5.345	50.799	46.097	18.809	169.153	21.527
4100	5.360	50.931	46.213	19.344	169.066	17.837
4200	5.375	51.061	46.327	19.881	168.979	14.150
4300	5.388	51.187	46.439	20.419	168.891	10.463
4400	5.402	51.311	46.548	20.959	168.804	6.779
4500	5.414	51.433	46.655	21.499	168.715	3.098
4600	5.426	51.552	46.760	22.042	168.627	-0.580
4700	5.437	51.669	46.863	22.585	168.538	-4.258
4800	5.448	51.783	46.965	23.129	168.447	-7.933
4900	5.459	51.896	47.064	23.674	168.356	-11.607
5000	5.468	52.006	47.162	24.221	168.265	-15.280
5100	5.477	52.115	47.258	24.768	168.171	-18.948
5200	5.486	52.221	47.352	25.316	168.077	-22.615
5300	5.494	52.326	47.445	25.865	167.982	-26.282
5400	5.502	52.428	47.537	26.415	167.886	-29.945
5500	5.509	52.529	47.627	26.966	167.788	-33.608
5600	5.516	52.629	47.715	27.517	167.689	-37.273
5700	5.523	52.726	47.802	28.069	167.588	-40.928
5800	5.529	52.822	47.888	28.621	167.485	-44.584
5900	5.535	52.917	47.972	29.175	167.382	-48.243
6000	5.541	53.010	48.055	29.728	167.276	-51.898

15 September 1962

CHW

CARBON, MONATOMIC (C) (IDEAL GAS)

gfw = 12.011

$$\Delta H^\circ_{f0} = 169.580 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = 170.890 \text{ Kcal gfw}^{-1}$$

Ground State Configuration 3P_0

$$S^\circ_{298.15} = 37.761 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 1.562 \text{ Kcal gfw}^{-1}$$

Electronic levels and multiplicities

Source of Data

Atomic energy levels from Moore¹.

Heat of Formation

Value consistent with JANAF² was chosen.

Heat Capacity and Entropy

Calculated on monatomic gas computer program.

References

1. Moore, C., Atomic Energy Levels, Vol.1, Nat'l. Bur. Stds. (1949).
2. JANAF Thermochemical Tables, Dow Chemical Co. (1960).

CARBON, MONATOMIC (C)

(IDEAL GAS)

GFW = 12.011

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	C_v	$-T \ln T - H_{298.15}$	$H_T - H_{298.15}$	ΔH_f	ΔF_f	ΔG_f
± 298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.450		
± 1000	± 0.000	± 0.002	± 0.002	± 0.000			
± 2000	± 0.000	± 0.002	± 0.002	± 0.000			
± 3000	± 0.000	± 0.002	± 0.002	± 0.000			
± 4000	± 0.000	± 0.002	± 0.002	± 0.001			
± 5000	± 0.000	± 0.002	± 0.002	± 0.001			
± 6000	± 0.000	± 0.002	± 0.002	± 0.001			

TABLE 109

HAFNIUM CARBIDE

CONDENSED PHASE

CHF

Reference State for Calculating ΔH_f° , ΔH_f° , and $\log K_p$: Solid Hf from 0° to 2495°K,
 Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K;
 Solid C, Solid HfC from 0° to 3900°K

T, °K	C_p	ΔH_f°	$(H_f - H_{298})/T$	$H_f - H_{298}$	ΔH_f°	ΔH_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.494	-54.807	-54.807	INFINITE
298.15	8.228	9.852	9.852	0.000	-55.000	-54.339	39.830
300	8.274	9.903	9.852	0.015	-55.001	-54.335	39.581
400	9.916	12.539	10.200	0.936	-54.990	-54.114	29.565
500	10.746	14.850	10.905	1.975	-54.974	-53.899	23.558
600	11.256	16.857	11.733	3.074	-54.976	-53.686	19.554
700	11.615	18.621	12.594	4.219	-54.998	-53.470	16.693
800	11.894	20.191	13.441	5.395	-55.039	-53.248	14.546
900	12.126	21.605	14.276	6.596	-55.101	-53.020	12.874
1000	12.329	22.894	15.075	7.819	-55.177	-52.786	11.536
1100	12.513	24.078	15.840	9.061	-55.267	-52.543	10.439
1200	12.684	25.174	16.573	10.321	-55.369	-52.290	9.523
1300	12.846	26.195	17.274	11.598	-55.486	-52.028	8.746
1400	13.002	27.153	17.946	12.890	-55.610	-51.758	8.079
1500	13.152	28.055	18.590	14.198	-55.743	-51.478	7.500
1600	13.299	28.909	19.209	15.521	-55.885	-51.190	6.992
1700	13.443	29.719	19.803	16.858	-56.033	-50.889	6.542
1800	13.584	30.492	20.376	18.209	-56.189	-50.585	6.142
1900	13.724	31.230	20.928	19.575	-56.351	-50.269	5.782
2000	13.863	31.948	21.461	20.954	-56.519	-49.944	5.457
2033	13.908	32.165	21.633	21.412	-56.575	-49.856	5.357
2033	13.908	32.165	21.633	21.412	-56.575	-49.856	5.357
2100	14.000	32.617	21.976	22.347	-56.742	-49.557	5.157
2200	14.136	33.272	22.474	23.754	-56.922	-49.133	4.881
2300	14.272	33.903	22.958	25.174	-57.107	-48.705	4.628
2400	14.406	34.513	23.427	26.608	-57.298	-48.266	4.395
2495	14.534	35.075	23.859	27.983	-57.494	-47.837	4.190
2495	14.534	35.075	23.859	27.983	-57.494	-47.837	4.190
2500	14.541	35.104	23.884	28.056	-57.520	-47.805	4.179
2600	14.674	35.677	24.323	29.516	-57.719	-47.368	3.963
2700	14.808	36.233	24.755	30.940	-57.925	-46.930	3.763
2800	14.941	36.774	25.175	32.478	-58.138	-46.486	3.577
2900	15.073	37.301	25.584	33.979	-58.357	-46.036	3.405
3000	15.206	37.814	25.983	35.492	-58.583	-45.589	3.245
3100	15.338	38.315	26.373	37.020	-58.817	-45.136	3.095
3200	15.470	38.804	26.754	38.560	-59.057	-44.678	2.954
3300	15.602	39.282	27.126	40.114	-59.303	-44.216	2.823
3400	15.733	39.750	27.491	41.680	-59.555	-43.750	2.699
3500	15.865	40.208	27.848	43.260	-59.813	-43.280	2.583
3600	15.996	40.656	28.197	44.853	-60.077	-42.806	2.473
3700	16.128	41.097	28.540	46.460	-60.347	-42.328	2.370
3800	16.254	41.528	28.876	48.079	-60.623	-41.846	2.273
3900	16.390	41.952	29.206	49.711	-60.905	-41.360	2.181

15 June 1963

HLS

$$\Delta H_{f298.15}^{\circ} = -55.0 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 9.852 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3900^{\circ}\text{K}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.494 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.3404 + 1.30 \times 10^{-3} T - 3.112 \times 10^{-5} T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3900^{\circ}\text{K}$$

Structure

Face-centered-cubic NaCl-type.

Heat of Formation

Intermediate value is based on equilibrium data from Zhelankin et al.,¹ vaporization data of Coffman et al.,² and calorimetry value of Kelley.³

Heat Capacity and Entropy

Low-temperature data are estimated.⁴ High-temperature data have been evaluated by Shomate method using data from Coffman et al.² and Neel et al.⁵ Data are extrapolated to 3900°K.

Melting and Vaporization

Melting point is estimated from observations of Bowman⁶ and data of Avarbe et al.⁷

References

1. Zhelankin, V. I. et al., Russ. J. Phys. Chem. 33, 251-253 (1959).
2. Coffman, J. A. et al., WADD TR 60-646, Part II (January 1963).
3. Kelley, K. K., private communication.
4. Schick, H. L., et al., Vol. 1, this work, section IVB9.2b1; also see section IID.
5. Neel, D. S., et al., WADD TR 60-924 (1961).
6. Bowman, M., discussions at A. D. Little colloquium (28-29 January 1963).
7. Avarbe, P. G., et al., Zh. Prikl. Khim. 35, 1976 (1962).

HAFNIUM CARBIDE (HfC)

(CONDENSED PHASE)

GFW = 190.511

SUMMARY OF UNCERTAINTY ESTIMATES

T, K	C_p	S_T	$(H_T - H_{298})$	$(H_T - H_{298})$	ΔH_f	ΔH_f	$\log K_f$
298.15	± 0.500	± 0.500	± 0.500	± 0.000	± 5.000		
1000	± 0.500	± 1.105	± 0.754	± 0.351			
1000	± 1.000	± 1.105	± 0.754	± 0.351			
2000	± 1.000	± 1.798	± 1.123	± 1.351			
2000	± 2.000	± 1.798	± 1.123	± 1.351			
3000	± 2.000	± 2.609	± 1.492	± 3.351			
3900	± 2.000	± 3.134	± 1.813	± 5.151			

TABLE 110

DIMOLYBDENUM CARBIDE

CONDENSED PHASE

CMo₂

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
 Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K, Solid C;
 Solid Mo₂C from 0° to 2693°K.

T, °K	$\overset{\text{cal./kgfw}}{C_p}$	$\overset{\text{cal./kgfw}}{S_T}$	$\overset{\text{cal./kgfw}}{(H_f - H_{298})^\circ}$	$\overset{\text{cal./kgfw}}{H_f^\circ}$	$\overset{\text{cal./kgfw}}{H_{298}^\circ}$	$\overset{\text{cal./kgfw}}{\Delta H_f^\circ}$	$\overset{\text{cal./kgfw}}{\Delta F_f^\circ}$	$\log K_p$
0								
298.15	12.553	17.100	17.100	0.000	-11.535	-12.155	8.910	
300	12.610	17.178	17.100	0.023	-11.538	-12.159	8.858	
400	14.710	21.131	17.625	1.402	-11.573	-12.359	6.753	
500	15.834	24.544	18.676	2.934	-11.576	-12.551	5.486	
600	16.573	27.500	19.906	4.557	-11.575	-12.751	4.644	
700	17.131	30.099	21.180	6.243	-11.584	-12.946	4.042	
800	17.592	32.417	22.443	7.980	-11.586	-13.141	3.590	
900	17.996	34.513	23.669	9.759	-11.594	-13.334	3.238	
1000	18.366	36.428	24.851	11.578	-11.601	-13.528	2.956	
1100	18.713	38.195	25.984	13.432	-11.630	-13.720	2.726	
1200	19.044	39.838	27.071	15.320	-11.678	-13.906	2.533	
1300	19.365	41.375	28.113	17.240	-11.747	-14.091	2.369	
1400	19.677	42.821	29.112	19.192	-11.831	-14.268	2.227	
1500	19.984	44.189	30.072	21.176	-11.911	-14.439	2.104	
1600	20.286	45.489	30.996	23.189	-12.028	-14.602	1.994	
1700	20.585	46.728	31.885	25.233	-12.172	-14.762	1.898	
1800	20.881	47.913	32.743	27.306	-12.346	-14.908	1.810	
1900	21.174	49.049	33.571	29.409	-12.553	-15.044	1.730	
2000	21.466	50.143	34.373	31.541	-12.796	-15.173	1.658	
2100	21.757	51.197	35.149	33.702	-13.078	-15.283	1.590	
2200	22.047	52.216	35.902	35.892	-13.405	-15.381	1.528	
2300	22.335	53.203	36.632	38.111	-13.776	-15.461	1.469	
2400	22.623	54.159	37.343	40.359	-14.197	-15.526	1.414	
2500	22.910	55.089	38.034	42.636	-14.672	-15.568	1.361	
2600	23.197	55.993	38.708	44.941	-15.206	-15.599	1.311	
2693	23.463	56.813	39.319	47.111	-15.754	-15.604	1.266	

15 September 1963

DFA

DIMOLYBDENUM CARBIDE (Mo_2C) (CONDENSED PHASE)

gfw = 203.91

$$\Delta H_{f298.15}^\circ = -11.54 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^\circ = 17.10 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2693^\circ\text{K}$$

$$C_p^\circ = 15.92 + (2.82 \times 10^{-3}) T - (3.74 \times 10^{-5}) T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^\circ\text{K} \leq T \leq 2693^\circ\text{K}$$

Structure

Dimolybdenum carbide has a hexagonal close-packed structure with $a = 3.002 \text{ \AA}$ and $c = 4.724 \text{ \AA}$.¹

Heat of Formation

The heat of formation was calculated from the free-energy functions and the free energy of formation at 1270°K that was determined by Gleiser and Chipman.²

Heat Capacity and Entropy

The heat capacity and entropy are estimates of Krikorian.³

Melting and Vaporization

The melting temperature was determined by Nadler and Kempter.⁴

References

1. Hansen, M., Constitution of Binary Alloys, McGraw-Hill, New York (1958).
2. Gleiser, M. and J. Chipman, J. Phys. Chem. 66, 1539 (1962).
3. Krikorian, O., Estimation of High Temperature Heat Capacities of Carbides, UCRL-6785 (1962).
4. Nadler, M.R. and C.P. Kempter, J. Phys. Chem., 64, 1468 (1960).

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid Nb from 0° to 2741°K,
Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K,
Solid C, Solid NbC from 0° to 3753°K, Liquid NbC from 3753° to 6000°K.

T, K	ΔH_f° , kcal/gw	ΔG_f° , kcal/gw	$\log K_p$	ΔH_f° , kcal/gw	ΔG_f° , kcal/gw	$\log K_p$
0	0.000	0.000	INFINITE	-1.258	-33.342	INFINITE
298.15	8.886	8.700	8.700	0.000	-33.600	24.266
300	8.919	8.755	8.700	0.016	-33.599	24.114
400	10.137	11.509	9.067	0.977	-33.484	18.004
500	10.793	13.848	9.796	2.026	-33.363	14.521
600	11.228	15.856	10.643	3.128	-33.258	11.925
700	11.559	17.613	11.515	4.268	-33.171	10.196
800	11.835	19.175	12.377	5.438	-33.098	8.904
900	12.078	20.583	13.212	6.634	-33.037	7.900
1000	12.301	21.867	14.014	7.853	-32.981	7.098
1100	12.511	23.050	14.782	9.094	-32.930	6.443
1200	12.712	24.147	15.518	10.355	-32.881	5.899
1300	12.907	25.172	16.221	11.636	-32.835	5.438
1400	13.097	26.135	16.892	12.936	-32.787	5.044
1500	13.283	27.045	17.542	14.255	-32.737	4.703
1600	13.468	27.909	18.163	15.593	-32.684	4.400
1700	13.650	28.731	18.761	16.949	-32.626	4.143
1800	13.830	29.516	19.337	18.323	-32.565	3.910
1900	14.010	30.268	19.892	19.715	-32.499	3.702
2000	14.188	30.992	20.429	21.125	-32.427	3.516
2100	14.366	31.686	20.949	22.552	-32.350	3.347
2200	14.543	32.361	21.452	23.998	-32.267	3.194
2300	14.719	33.011	21.941	25.461	-32.178	3.055
2400	14.895	33.641	22.415	26.942	-32.084	2.928
2500	15.071	34.253	22.877	28.440	-31.983	2.811
2600	15.246	34.847	23.326	29.956	-31.877	2.704
2700	15.421	35.426	23.763	31.489	-31.766	2.605
2741	15.492	35.659	23.939	32.123	-31.715	2.566
2741	15.492	35.659	23.939	32.123	-31.715	2.566
2800	15.565	35.940	24.190	33.040	-31.605	2.502
2900	15.770	36.540	24.606	34.608	-31.485	2.400
3000	15.964	37.078	25.013	36.194	-31.350	2.306
3100	16.118	37.603	25.411	37.797	-31.203	2.217
3200	16.292	38.118	25.800	39.417	-31.044	2.135
3300	16.466	38.622	26.181	41.055	-30.873	2.058
3400	16.640	39.116	26.554	42.711	-30.697	1.986
3500	16.813	39.601	26.920	44.383	-30.510	1.919
3600	16.987	40.077	27.279	46.073	-30.313	1.856
3700	17.160	40.545	27.631	47.781	-30.104	1.796
3753	17.252	40.769	27.815	48.693	-30.010	1.766
3753	17.252	40.769	27.815	48.693	-30.010	1.766
3800	17.252	40.866	28.049	49.503	-30.000	1.750
3900	17.252	41.314	28.538	51.359	-30.000	1.757
4000	17.252	41.751	29.012	53.229	-30.000	1.710
4100	17.252	42.177	29.472	55.105	-30.000	1.701
4200	17.252	42.594	29.920	57.000	-30.000	1.685
4300	17.252	43.000	30.356	58.912	-30.000	1.670
4400	17.252	43.395	30.782	60.840	-30.000	1.656
4500	17.252	43.783	31.200	62.780	-30.000	1.643
4600	17.252	44.162	31.618	64.735	-30.000	1.631
4700	17.252	44.533	32.016	66.700	-30.000	1.620
4800	17.252	44.896	32.406	68.675	-30.000	1.610
4900	17.252	45.252	32.787	70.661	-30.000	1.600
5000	17.252	45.601	33.159	72.650	-30.000	1.591
5031.58	17.252	45.709	33.270	73.721	-30.012	1.591
5031.58	17.252	45.709	33.270	73.721	-30.012	1.591
5100	17.252	46.062	33.634	75.700	-30.000	1.590
5200	17.252	46.417	34.000	77.681	-30.000	1.590
5300	17.252	46.773	34.366	79.661	-30.000	1.590
5400	17.252	47.130	34.732	81.640	-30.000	1.590
5500	17.252	47.487	35.098	83.620	-30.000	1.590
5600	17.252	47.844	35.464	85.600	-30.000	1.590
5700	17.252	48.201	35.830	87.580	-30.000	1.590
5800	17.252	48.558	36.196	89.560	-30.000	1.590
5900	17.252	48.915	36.562	91.540	-30.000	1.590
6000	17.252	49.272	36.928	93.520	-30.000	1.590

NIOBIUM CARBIDE (NbC)

(CONDENSED PHASE)

gfw = 104.921

$$\Delta H_f^{\circ} 298.15 = -33.6 \text{ kcal gfw}^{-1}$$

$$S^{\circ} 298.15 = 8.7 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3753^{\circ}\text{K}$$

$$\Delta H_m = 22.000 \text{ kcal gfw}^{-1}$$

$$H^{\circ} 298.15 - H^{\circ}_0 = 1.258 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 10.79 + 1.726 \times 10^{-3}T - 2.15 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 1840^{\circ}\text{K}$$

Structure

Cubic NaCl B1-type with a variable range of homogeneity.

Heat of Formation

Combustion data reported by Huber *et al*¹ have been used.

Heat Capacity and Entropy

Low-temperature data are estimated. High-temperature data of Gel'd and Kusenko are extrapolated to the melting point. Heat capacity of liquid is estimated equal to the heat capacity of solid at the melting point.

Melting and Vaporization

Heat of fusion is estimated.

References

1. Huber, E. J., Jr., *et al*, J. Phys. Chem. 65, 1846 (1961).
2. Gel'd, P. V. and F. G. Kusenko, Izv. A. N. SSSR O. T. N. Met. i Top. (2), 79-86 (1960).

NIOBIUM CARBIDE (NbC)

(CONDENSED PHASE)

gfw = 104.921

SUMMARY OF UNCERTAINTY ESTIMATES

T K	C_p	C_p	$(H_T - H_{298})/T$	$(H_T - H_{298})$	ΔH_f	ΔH_f	$\log K_p$
298.15	± 0.500	± 0.500	± 0.500	± 0.000	± 0.800		
1000	± 0.500	± 1.105	± 0.754	± 0.351			
1000	± 1.000	± 1.105	± 0.754	± 0.351			
2000	± 1.000	± 1.798	± 1.123	± 1.351			
3000	± 1.000	± 2.204	± 1.420	± 2.351			
3753	± 1.000	± 2.428	± 1.601	± 3.104			
3753	± 2.000	± 3.760	± 1.601	± 8.104			
4000	± 2.000	± 3.887	± 1.738	± 8.598			
5000	± 2.000	± 4.334	± 2.214	± 10.598			
6000	± 2.000	± 4.698	± 2.599	± 12.598			

TABLE 112

DINIOBIUM CARBIDE

CONDENSED PHASE

CnD₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Nb from 0° to 2741°K,
 Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K,
 Solid C, Solid Nb₂C from 0° to 3363°K.

T, K	ΔG_p	ΔH_p	ΔF_p	$\Delta H_p - \Delta F_p$	ΔH_f	ΔF_f	Log K_p
0	0.000	0.000	INFINITE	-2.472	-46.292	-46.292	INFINITE
298.15	14.468	16.000	16.000	0.000	-46.600	-45.599	33.423
300	14.502	16.090	16.000	0.027	-46.599	-45.592	33.212
400	15.799	20.460	16.587	1.549	-46.523	-45.267	24.731
500	16.560	24.073	17.734	3.169	-46.440	-44.964	19.653
600	17.111	27.143	19.057	4.854	-46.371	-44.675	16.272
700	17.562	29.815	20.403	6.588	-46.318	-44.397	13.861
800	17.960	32.166	21.731	8.365	-46.276	-44.126	12.054
900	18.327	34.323	23.013	10.179	-46.245	-43.859	10.650
1000	18.675	36.272	24.243	12.029	-46.215	-43.597	9.528
1100	19.011	38.068	25.419	13.914	-46.187	-43.334	8.609
1200	19.338	39.738	26.543	15.831	-46.158	-43.077	7.845
1300	19.654	41.297	27.619	17.781	-46.129	-42.822	7.199
1400	19.975	42.765	28.649	19.763	-46.095	-42.567	6.645
1500	20.289	44.154	29.637	21.776	-46.056	-42.317	6.165
1600	20.600	45.473	30.586	23.821	-46.011	-42.070	5.746
1700	20.909	46.732	31.499	25.896	-45.958	-41.826	5.377
1800	21.217	47.935	32.379	28.002	-45.899	-41.585	5.049
1900	21.523	49.071	33.228	30.139	-45.832	-41.345	4.755
2000	21.829	50.103	34.049	32.307	-45.755	-41.110	4.492
2100	22.134	51.275	34.844	34.505	-45.670	-40.880	4.254
2200	22.438	52.312	35.615	36.734	-45.576	-40.658	4.039
2300	22.741	53.316	36.362	38.993	-45.473	-40.434	3.842
2400	23.044	54.290	37.087	41.282	-45.363	-40.218	3.662
2500	23.347	55.237	37.796	43.601	-45.242	-40.002	3.497
2600	23.650	56.158	38.485	45.951	-45.113	-39.798	3.345
2700	23.952	57.057	39.156	48.331	-44.973	-39.596	3.205
2741	24.076	57.414	39.427	49.316	-44.912	-39.517	3.151
2741	24.076	57.414	39.427	49.316	-57.712	-39.517	3.151
2800	24.254	57.933	39.811	50.742	-57.585	-39.124	3.054
2900	24.556	58.790	40.451	53.182	-57.349	-38.468	2.899
3000	24.857	59.627	41.076	55.653	-57.083	-37.825	2.755
3100	25.154	60.447	41.688	58.154	-56.788	-37.185	2.621
3200	25.446	61.251	42.287	60.685	-56.465	-36.562	2.497
3300	25.761	62.039	42.873	63.246	-56.114	-35.944	2.380
3363	25.951	62.528	43.237	64.875	-55.841	-35.563	2.311

15 June 1963

HLS

$$\Delta H_f^{\circ}{}_{298.15} = -46.6 \text{ kcal gfw}^{-1}$$

$$S^{\circ}{}_{298.15} = 16.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = T \text{ (peritectic)} = 3363^{\circ}\text{K}$$

$$H^{\circ}{}_{298.15} - H^{\circ}{}_0 = 2.472 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 15.88 + 3.0 \times 10^{-3} T - 2.050 \times 10^{-5} T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 1890^{\circ}\text{K}$$

Structure

Hexagonal close-packed type with a variable range of homogeneity.

Heat of Formation

Huber et al¹ have used bomb calorimetry to obtain the heat of formation.

Heat Capacity and Entropy

Entropy at 298.15°K has been estimated. High-temperature heat-capacity data of Gel'd and Kusenko² have been extrapolated to peritectic temperature.

References

1. Huber, E. J., Jr., et al, J. Phys. Chem. 65, 1846 (1961).
2. Gel'd, P. V. and F. G. Kusenko, Izv. Akad. Nauk SSSR OTN Met., Top. 1960, 79-86 (1960).

DINIOBIUM CARBIDE (Nb₂C)

(CONDENSED PHASE)

GFW = 197.831

SUMMARY OF UNCERTAINTY ESTIMATES

T, K	ΔC_p	ΔH_f	ΔH_m	ΔH_f	ΔH_m	ΔH_f	ΔH_m	ΔH_f	ΔH_m	ΔH_f	ΔH_m
298.15	± 0.500	± 1.500	± 1.500	± 0.000	± 2.000						
1000	± 0.500	± 2.105	± 1.754	± 0.351							
1000	± 1.000	± 2.105	± 1.754	± 0.351							
2000	± 1.000	± 2.798	± 2.123	± 1.351							
2000	± 1.000	± 2.798	± 2.123	± 1.351							
3000	± 1.000	± 3.204	± 2.420	± 2.351							
3363	± 1.000	± 3.318	± 2.511	± 2.714							

TABLE 113

SILICON CARBIDE

CONDENSED PHASE

CSI

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$ Solid Si from 0 to 1690°K, Liquid Si from 1690° to 3566°K, Gaseous Si from 3566° to 6000°K, Solid C, Solid SiC from 0° to 3103°K

T, °K	C_p cal/°K gfw	S_T° cal/°K gfw	$-(F_T^\circ - H_{298}^\circ)/T$ cal/°K gfw	$H_T^\circ - H_{298}^\circ$ Kcal/gfw	ΔH_f° Kcal/gfw	ΔF_f° Kcal/gfw	$\log K_p$
0	0.000	0.000	INFINITE	-0.781	-16.260	-16.260	INFINITE
298.15	6.418	3.970	3.970	0.000	-16.500	-15.928	11.675
300	6.472	4.010	3.970	0.012	-16.501	-15.924	11.600
400	8.423	6.175	4.252	0.769	-16.498	-15.731	8.594
500	9.424	8.173	4.840	1.666	-16.469	-15.542	6.793
600	10.051	9.950	5.547	2.642	-16.445	-15.360	5.595
700	10.501	11.535	6.291	3.671	-16.432	-15.180	4.739
800	10.857	12.961	7.037	4.739	-16.428	-15.002	4.098
900	11.159	14.257	7.758	5.840	-16.431	-14.823	3.599
1000	11.426	15.447	8.478	6.970	-16.436	-14.645	3.201
1100	11.671	16.548	9.162	8.125	-16.443	-14.465	2.874
1200	11.901	17.573	9.821	9.303	-16.450	-14.286	2.602
1300	12.121	18.535	10.454	10.505	-16.455	-14.104	2.371
1400	12.332	19.441	11.064	11.727	-16.456	-13.923	2.173
1500	12.538	20.299	11.651	12.971	-16.453	-13.741	2.002
1600	12.740	21.114	12.218	14.235	-16.444	-13.562	1.852
1690	12.916	21.816	12.710	15.389	-16.430	-13.399	1.733
1690	12.918	21.816	12.710	15.389	-28.380	-13.399	1.733
1700	12.938	21.893	12.764	15.519	-28.377	-13.311	1.711
1800	13.134	22.638	13.292	16.822	-28.356	-12.425	1.509
1900	13.327	23.353	13.803	18.145	-28.326	-11.541	1.327
2000	13.519	24.041	14.298	19.488	-28.285	-10.660	1.165
2100	13.709	24.706	14.777	20.849	-28.226	-9.778	1.018
2200	13.899	25.348	15.243	22.230	-28.152	-8.901	0.884
2300	14.087	25.970	15.696	23.629	-28.060	-8.031	0.763
2400	14.275	26.573	16.137	25.047	-27.953	-7.162	0.652
2500	14.462	27.160	16.565	26.484	-27.827	-6.298	0.551
2600	14.648	27.731	16.985	27.939	-27.687	-5.440	0.457
2700	14.834	28.287	17.393	29.413	-27.528	-4.588	0.371
2800	15.020	28.830	17.792	30.906	-27.352	-3.740	0.292
2900	15.205	29.360	18.182	32.417	-27.160	-2.902	0.219
3000	15.390	29.879	18.563	33.947	-26.951	-2.067	0.151
3100	15.574	30.386	18.936	35.495	-26.724	-1.242	0.088
3103	15.580	30.401	18.947	35.542	-26.716	-1.215	0.086

31 December 1963

HLS

SILICON CARBIDE (β -SiC) (CONDENSED PHASE) gfw = 40.101

$$\Delta H_{f, 298.15}^{\circ} = -16.5 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 3.97 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_{\text{peritectic}} = 3103^{\circ}\text{K}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 0.781 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 9.97 + 1.82 \times 10^{-3}T - 3.64 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3103^{\circ}\text{K}$$

Structure

β -SiC has a cubic structure. The temperature of transformation to the high temperature, i. e., hexagonal or α -form of SiC, is ill defined. Present table gives data for only cubic-SiC, but data for hexagonal SiC are probably not very different.

Heat of Formation

A variety of calorimetric, Si-C-O equilibria, vaporization, solubility, and phase-diagram data reviewed. Final choice based on Si-C-O equilibria. 1, 2, 3 See volume 1, this report (section IVB25. 2) for details.

Heat Capacity and Entropy

Low-temperature data from Kelley and King. 4 High-temperature data from Kelley. 5

Melting and Vaporization

Peritectic decomposition value from Scace and Slack. 6

References

1. Baird, J. D. and J. Taylor, Trans. Faraday Soc. 54, 526 (1958).
2. Kay, D. and J. Taylor, Trans. Faraday Soc. 56, 1372 (1960).
3. Rein, R. and J. Chipman, J. Phys. Chem. 67, 839 (1963).
4. Kelley, K. and E. King, U. S. Bur. Mines, Bull. 592 (1961).
5. Kelley, K., U. S. Bur. Mines, Bull. 584 (1960).
6. Scace, R. and G. Slack, J. Chem. Phys. 30, 1551 (1959).

SILICON CARBIDE (SiC)

(CONDENSED PHASE)

GFW = 40.101

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal °K gfw				Kcal gfw		Log K _p
	C_p°	γ_T	$-(F_T - H_{298}^{\circ})/T$	$H_T - H_{298}^{\circ}$	ΔH_f	ΔF_f	
298.15	± 0.100	± 0.020	± 0.020	± 0.000	± 2.606		
1000	± 0.100	± 0.141	± 0.071	± 0.070			
1000	± 0.500	± 0.141	± 0.071	± 0.070			
2000	± 0.500	± 0.488	± 0.202	± 0.570			
2000	± 2.000	± 0.488	± 0.202	± 0.570			
3000	± 2.000	± 1.299	± 0.442	± 2.570			
3103	± 2.000	± 1.366	± 0.471	± 2.776			

TABLE III

TANTALUM CARBIDE

CONDENSED PHASE

CTa

Reference State for Calculating ΔH_f , ΔG_f , and $\log K_p$: Solid Ta from 0° to 3270°K,
 Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K, Solid C,
 Solid TaC from 0° to 4273°K, Liquid TaC from 4273° to 6000°K

T, °K	C_p	S_T	$\frac{-(H_T - H_{298})}{T}$	$H_T - H_{298}$	ΔH_f	ΔG_f	$\log K_p$
0	0.000	0.000	INFINITE	-1.557	-34.547	-34.547	INFINITE
298.15	8.790	10.110	10.110	0.000	-34.600	-34.251	25.106
300	8.824	10.164	10.110	0.016	-34.599	-34.249	24.949
400	10.118	12.901	10.475	0.971	-34.509	-34.146	18.655
500	10.862	15.245	11.200	2.022	-34.410	-34.066	14.890
600	11.391	17.274	12.047	3.136	-34.316	-34.007	12.386
700	11.817	19.063	12.924	4.297	-34.229	-33.962	10.603
800	12.189	20.665	13.793	5.498	-34.143	-33.930	9.269
900	12.529	22.121	14.639	6.734	-34.054	-33.908	8.234
1000	12.850	23.458	15.455	8.003	-33.957	-33.898	7.408
1100	13.158	24.697	16.239	9.303	-33.849	-33.896	6.734
1200	13.457	25.855	16.993	10.634	-33.729	-33.906	6.175
1300	13.750	26.943	17.717	11.994	-33.597	-33.927	5.703
1400	14.038	27.973	18.413	13.384	-33.448	-33.956	5.301
1500	14.323	28.951	19.083	14.802	-33.287	-33.998	4.953
1600	14.606	29.885	19.729	16.248	-33.110	-34.051	4.651
1700	14.886	30.779	20.353	17.723	-32.915	-34.115	4.386
1800	15.166	31.637	20.956	19.226	-32.706	-34.191	4.151
1900	15.444	32.465	21.541	20.756	-32.481	-34.283	3.943
2000	15.721	33.264	22.107	22.314	-32.243	-34.384	3.757
2100	15.997	34.038	22.657	23.900	-31.990	-34.497	3.590
2200	16.272	34.788	23.191	25.514	-31.725	-34.620	3.439
2300	16.547	35.518	23.711	27.155	-31.450	-34.759	3.303
2400	16.822	36.228	24.218	28.823	-31.167	-34.910	3.179
2500	17.096	36.920	24.712	30.519	-30.881	-35.070	3.066
2600	17.370	37.596	25.195	32.242	-30.590	-35.245	2.962
2700	17.644	38.257	25.667	33.993	-30.306	-35.429	2.868
2800	17.917	38.903	26.128	35.771	-30.036	-35.625	2.781
2900	18.190	39.537	26.579	37.576	-29.793	-35.827	2.700
3000	18.463	40.158	27.022	39.409	-29.585	-36.043	2.626
3100	18.736	40.768	27.455	41.269	-29.420	-36.259	2.556
3200	19.008	41.367	27.881	43.156	-29.307	-36.482	2.491
3270	19.199	41.780	28.174	44.493	-29.242	-36.637	2.449
3270	19.199	41.780	28.174	44.493	-35.111	-36.637	2.449
3300	19.281	41.956	28.298	45.071	-35.812	-36.646	2.427
3400	19.553	42.536	28.708	47.012	-35.341	-36.677	2.357
3500	19.826	43.106	29.112	48.981	-34.836	-36.725	2.293
3600	20.098	43.669	29.508	50.978	-34.303	-36.785	2.233
3700	20.370	44.223	29.898	53.001	-33.746	-36.861	2.177
3800	20.642	44.770	30.283	55.052	-33.162	-36.956	2.125
3900	20.914	45.310	30.661	57.129	-32.554	-37.065	2.077
4000	21.186	45.843	31.034	59.234	-31.919	-37.188	2.032
4100	21.458	46.369	31.402	61.367	-31.258	-37.331	1.990
4200	21.730	46.889	31.764	63.526	-30.573	-37.481	1.950
4273	21.929	47.265	32.026	65.120	-30.000	-37.608	1.923
4273	16.000	53.116	32.026	90.120	-5.056	-37.608	1.923
4300	16.000	53.217	32.158	90.552	-5.023	-37.812	1.922
4400	16.000	53.585	32.641	92.152	-4.700	-38.578	1.916
4500	16.000	53.944	33.111	93.752	-4.179	-39.347	1.911
4600	16.000	54.296	33.567	95.352	-4.660	-40.111	1.906
4700	16.000	54.640	34.012	96.952	-4.542	-40.884	1.901
4800	16.000	54.977	34.445	98.552	-4.427	-41.656	1.897
4900	16.000	55.307	34.868	100.152	-4.313	-42.440	1.893
5000	16.000	55.630	35.280	101.752	-4.201	-43.220	1.889
5100	16.000	55.947	35.682	103.352	-4.092	-43.994	1.885
5200	16.000	56.258	36.075	104.952	-3.984	-44.782	1.882
5300	16.000	56.562	36.458	106.552	-3.878	-45.566	1.879
5400	16.000	56.862	36.833	108.152	-3.774	-46.350	1.876
5500	16.000	57.155	37.200	109.752	-3.673	-47.140	1.873
5600	16.000	57.443	37.559	111.352	-3.573	-47.934	1.871
5700	16.000	57.727	37.911	112.952	-3.476	-48.730	1.868
5706.65	16.000	57.745	37.934	113.058	-3.469	-48.787	1.868
5706.65	16.000	57.745	37.934	113.058	-184.692	-48.787	1.868
5800	16.000	58.005	38.255	114.552	-184.757	-46.560	1.754
5900	16.000	58.278	38.592	116.152	-184.832	-44.182	1.637
6000	16.000	58.547	38.922	117.752	-184.912	-41.794	1.522

15 September 1961

HLS

TANTALUM CARBIDE (TaC) (CONDENSED PHASE) gfw = 192.961

$$\begin{aligned}\Delta H_{f,298.15}^{\circ} &= -34.6 \pm 0.9 \text{ kcal gfw}^{-1} & S_{298.15}^{\circ} &= 10.11 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \\ T_m &= 4273^{\circ}\text{K} & \Delta H_m &= 25. \text{ kcal gfw}^{-1} \\ H_{298.15}^{\circ} - H_0^{\circ} &= 1.557 \text{ kcal gfw}^{-1} \\ C_p^{\circ} &= 10.347 + 0.0027131T - 2.1033 \times 10^{-5}T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 298.15^{\circ}\text{K} \leq T \leq 4273^{\circ}\text{K} \\ C_p^{\circ} &= 16.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 4273^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}\end{aligned}$$

Structure

TaC exists in a f. c. c. structure with variable homogeneity range.

Heat of Formation

Heat of formation is from Huber et al.¹

Heat Capacity and Entropy

Low-temperature data of Kelley² was used. High-temperature data of Neel, et al³ and Mezaki⁴ was combined by Shomate method and extrapolated to melting point. Data above melting point was estimated.

Melting and Vaporization

Heat of fusion was estimated.

References

1. Huber, E. J. Jr., et al, J. Phys. Chem. 67, 793 (1963).
2. Kelley, K. K., J. Am. Chem. Soc. 62, 818 (1940).
3. Neel, D. S., et al, WADD TR 60-924 (1962).
4. Mezaki, R., Thesis, M. S., U. of Wisconsin (1961).

TANTALUM CARBIDE (TaC) (CONDENSED PHASE) GFW = 192.961

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±0.500	±0.080	±0.080	±0.000	±0.900		
1000	±0.500	±0.685	±0.334	±0.351			
1000	±2.000	±0.685	±0.334	±0.351			
2000	±2.000	±2.071	±0.896	±2.351			
3000	±2.000	±2.882	±1.432	±4.351			
4000	±2.000	±3.458	±1.870	±6.351			
4273	±2.000	±3.590	±1.976	±6.897			
4273	±3.000	±4.760	±1.976	±11.897			
5000	±3.000	±5.231	±2.416	±14.078			
6000	±3.000	±5.778	±2.932	±17.078			

TABLE 115

DILANTANIUM CARBIDE

CONDENSED PHASE

CTa₂

Reference State for Calculating ΔH_f , ΔH_c , and $\log K_p$: Solid Ta from 0° to 3270°K,
 Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K,
 Solid Ta₂C from 0° to 3773°K

T, °K	C_p	ΔH_f , kcal/gfw Ta	ΔH_c , kcal/gfw Ta ₂ C	ΔH_f , kcal/gfw Ta ₂ C	ΔH_f , kcal/gfw Ta ₂ C	ΔH_f , kcal/gfw Ta ₂ C	ΔH_f , kcal/gfw Ta ₂ C	$\log K_p$
0	0.000	0.000	INFINITE	-2.729	-46.961	-46.961	INFINITE	
298.15	14.567	19.500	19.500	0.000	-47.200	-46.693	34.226	
300	14.601	19.590	19.590	0.027	-47.199	-46.690	34.012	
400	15.931	23.993	20.022	1.561	-47.149	-46.528	25.420	
500	16.725	27.639	21.247	3.196	-47.099	-46.378	20.271	
600	17.302	30.742	22.577	4.899	-47.058	-46.239	16.842	
700	17.793	33.448	23.941	6.555	-47.025	-46.104	14.394	
800	18.224	35.852	25.282	8.156	-46.995	-45.975	12.559	
900	18.624	38.022	26.579	10.298	-46.960	-45.849	11.133	
1000	19.005	40.004	27.824	12.180	-46.916	-45.730	9.994	
1100	19.374	41.833	29.016	14.099	-46.858	-45.614	9.062	
1200	19.734	43.534	30.155	16.054	-46.789	-45.503	8.287	
1300	20.088	45.127	31.246	18.045	-46.705	-45.399	7.632	
1400	20.437	46.622	32.292	20.072	-46.604	-45.302	7.072	
1500	20.784	48.051	33.296	22.133	-46.493	-45.214	6.587	
1600	21.128	49.423	34.260	24.228	-46.366	-45.131	6.164	
1700	21.470	50.694	35.189	26.358	-46.222	-45.058	5.792	
1800	21.811	51.931	36.085	28.522	-46.067	-44.993	5.463	
1900	22.150	53.114	36.951	30.720	-45.897	-44.941	5.169	
2000	22.489	54.264	37.788	32.952	-45.720	-44.896	4.906	
2100	22.827	55.370	38.599	35.218	-45.533	-44.859	4.668	
2200	23.164	56.439	39.386	37.518	-45.340	-44.828	4.453	
2300	23.500	57.476	40.150	39.851	-45.147	-44.810	4.258	
2400	23.836	58.484	40.893	42.218	-44.955	-44.802	4.080	
2500	24.172	59.464	41.616	44.618	-44.779	-44.797	3.916	
2600	24.508	60.418	42.321	47.052	-44.610	-44.803	3.766	
2700	24.843	61.349	43.009	49.520	-44.476	-44.810	3.627	
2800	25.178	62.259	43.680	52.021	-44.390	-44.828	3.499	
2900	25.513	63.148	44.336	54.555	-44.376	-44.842	3.379	
3000	25.847	64.019	44.978	57.123	-44.453	-44.863	3.268	
3100	26.182	64.872	45.606	59.725	-44.635	-44.872	3.163	
3200	26.516	65.708	46.221	62.359	-44.941	-44.874	3.065	
3270	26.750	66.285	46.644	64.224	-45.131	-44.865	2.998	
3270	26.750	66.285	46.644	64.224	-58.131	-44.865	2.998	
3300	26.850	66.529	46.824	65.028	-58.131	-44.745	2.963	
3400	27.184	67.336	47.415	67.729	-58.132	-44.334	2.850	
3500	27.518	68.129	47.996	70.465	-57.709	-43.931	2.743	
3600	27.852	69.009	48.566	73.233	-57.255	-43.546	2.643	
3700	28.186	69.676	49.126	76.035	-56.769	-43.171	2.550	
3773	28.430	70.229	49.529	78.102	-56.392	-42.903	2.485	

15 September 1963

HLS

DITANTALUM CARBIDE (Ta_2C) (CONDENSED PHASE) gfw = 373.911

$$\Delta H_f^{\circ}_{298.15} = -47.2 \pm 3.4 \text{ kcal gfw}^{-1} \quad S^{\circ}_{298.15} = 19.5 \pm 1 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = T_{\text{peritectic}} = 3773 \text{ }^{\circ}\text{K}$$

$$H^{\circ}_{298.15} - H^{\circ}_0 = 2.729 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 15.88 + 3.33 \times 10^{-3}T - 2.050 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15 \text{ }^{\circ}\text{K} \leq T \leq 3773 \text{ }^{\circ}\text{K}$$

Structure

Ta_2C is hexagonal with variable range of homogeneity.

Heat of Formation

Combustion value from Huber et al¹

Heat Capacity and Entropy

Low-temperature and high-temperature data were estimated.

Melting and Vaporization

Peritectic temperature is given by Storms.²

References

1. Huber, E. J., Jr., et al, J. Phys. Chem. 67, 793 (1963).
2. Storms, E. K., LAMS-2674, (March 1962).

DITANTALUM CARBIDE (Ta_2C) (CONDENSED PHASE) gfw = 373.911

SUMMARY OF UNCERTAINTY ESTIMATE

T, K	ΔH_f°	$H^{\circ}_{298.15} - H^{\circ}_0$	C_p°	S°	ΔG_f°
298.15	± 1.000	± 1.000	± 1.000	± 0.000	± 1.000
1000	± 1.000	± 2.210	± 1.508	± 0.702	
1000	± 3.00	± 2.210	± 1.508	± 0.702	
2000	± 3.000	± 4.290	± 2.432	± 3.702	
3000	± 3.000	± 5.505	± 3.272	± 6.702	
3773	± 3.000	± 6.114	± 3.803	± 9.021	

TABLE 116

THORIUM CARBIDE

CONDENSED PHASE

CTh

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid Th from 0° to 2028°K,
 Liquid Th from 2028° to 5060°K, Gaseous Th from 5060° to 6000°K,
 Solid C, Solid ThC from 0° to 2898°K.

T, °K	ΔH_f° K cal/gfw	ΔG_f° K cal/gfw	ΔH_f° K cal/gfw	ΔG_f° K cal/gfw	ΔH_f° K cal/gfw	ΔG_f° K cal/gfw	$\log K_p$
0	---	---	---	---	---	---	---
298.15	10.198	11.500	11.500	0.000	-7.000	-6.219	4.559
300	10.235	11.563	11.500	0.019	-6.997	-6.214	4.527
400	11.628	14.723	11.922	1.121	-6.808	-5.981	3.268
500	12.373	17.405	12.757	2.374	-6.615	-5.797	2.534
600	12.863	19.707	13.728	3.587	-6.448	-5.649	2.058
700	13.233	21.718	14.729	4.893	-6.310	-5.527	1.726
800	13.538	23.506	15.717	6.231	-6.199	-5.424	1.482
900	13.807	25.116	16.673	7.599	-6.112	-5.332	1.295
1000	14.052	26.584	17.592	8.992	-6.046	-5.250	1.147
1100	14.282	27.934	18.471	10.409	-6.006	-5.172	1.027
1200	14.502	29.186	19.313	11.848	-5.998	-5.098	0.928
1300	14.714	30.355	20.118	13.309	-6.029	-5.021	0.844
1400	14.921	31.453	20.889	14.791	-6.104	-4.941	0.771
1500	15.125	32.490	21.628	16.293	-6.237	-4.855	0.707
1600	15.325	33.472	22.338	17.816	-6.38	-4.755	0.649
1633	15.391	33.786	22.566	18.322	-6.522	-4.719	0.631
1633	15.391	33.786	22.566	18.322	-7.175	-4.719	0.631
1700	15.523	34.407	23.020	19.358	-7.261	-4.615	0.593
1800	15.719	35.300	23.678	20.920	-7.378	-4.457	0.541
1900	15.914	36.155	24.312	22.502	-7.478	-4.291	0.494
2000	16.108	36.977	24.925	24.103	-7.562	-4.122	0.450
2028	16.162	37.201	25.093	24.555	-7.582	-4.074	0.439
2028	16.162	37.201	25.093	24.555	-11.435	-4.074	0.439
2100	16.301	37.767	25.618	25.724	-11.481	-3.810	0.397
2200	16.493	38.630	26.092	27.363	-11.533	-3.443	0.342
2300	16.684	39.267	26.649	29.022	-11.566	-3.076	0.292
2400	16.875	39.981	27.190	30.700	-11.583	-2.706	0.246
2500	17.065	40.674	27.715	32.397	-11.582	-2.335	0.204
2600	17.255	41.347	28.227	34.113	-11.565	-1.966	0.165
2700	17.445	42.002	28.725	35.848	-11.530	-1.600	0.130
2800	17.634	42.640	29.210	37.602	-11.477	-1.229	0.096
2898	17.820	43.250	29.675	39.339	-11.410	-0.874	0.066

15 September 1963

MBP

THORIUM CARBIDE (ThC)

(CONDENSED PHASE)

gfw = 244.061

$$\Delta H_f^{\circ}{}_{298.15} = -7 \pm 6 \text{ kcal gfw}^{-1}$$

$$S^{\circ}{}_{298.15} = 11.5 \pm 5 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2898 \pm 25 \text{ }^{\circ}\text{K}$$

$$C_p^{\circ} = (12.43 \pm .30) + (1.87 \pm .04) \times 10^{-3}T - (2.48 \pm 0.40) \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$298 \text{ }^{\circ}\text{K} \leq T \leq 2898 \text{ }^{\circ}\text{K}$$

Face-centered cubic (NaCl type)

Heat of FormationMeasured by Huber and Holley¹Heat Capacity and EntropyEmpirical equation developed by Krikorian.²Melting and VaporizationMelting point - Wilhelm & Chiotti.³References

1. Huber, E. J., Jr., and C. E. Holley Jr., Paper No. 26, IAEA Symposium, Vienna, June 1962.
2. Krikorian, O. H., UCRL 2888
3. Wilhelm, H., and Chiotti, P., Trans. Am. Soc. Met. 42, 1295 (1950).

THORIUM CARBIDE (ThC)

(CONDENSED PHASE)

GFW = 244.061

SUMMARY OF UNCERTAINTY ESTIMATES

TEMP	ENTHALPY	ENTHALPY	ENTHALPY	ENTHALPY	ENTHALPY
	ΔH_f°	ΔH_f°	ΔH_f°	ΔH_f°	ΔH_f°
298.15	± 0.256	± 0.500	± 0.500	± 0.000	± 6.000
500	± 0.300	± 0.645	± 0.531	± 0.057	
1000	± 0.335	± 0.865	± 0.648	± 0.217	
1500	± 0.358	± 1.006	± 0.745	± 0.390	
2000	± 0.379	± 1.112	± 0.826	± 0.575	
2500	± 0.399	± 1.198	± 0.891	± 0.769	
2898	± 0.415	± 1.258	± 0.937	± 0.931	

TABLE 117

TITANIUM CARBIDE

CONDENSED PHASE

CTI

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K, Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K, Solid C, Solid TiC from 0° to 3212°K, Liquid TiC from 3212° to 6000°K

T, °K	C_p	$\frac{\text{cal}}{^\circ\text{K gfw}}$ $\frac{H_T^\circ - H_{298}^\circ}{T}$	$\frac{\text{cal}}{^\circ\text{K gfw}}$ $-\left(\frac{H_T^\circ}{T} - \frac{H_{298}^\circ}{298}\right)$	$\frac{\text{Kcal}}{\text{gfw}}$ $H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.101	-43.829	-43.829	INFINITE
298.15	8.041	5.790	5.790	0.000	-44.130	-43.266	31.713
300	8.092	5.840	5.790	0.015	-44.130	-43.260	31.514
400	9.912	6.453	6.134	0.928	-44.083	-42.976	23.480
500	10.798	10.770	6.835	1.768	-44.011	-42.707	18.666
600	11.316	12.788	7.663	3.075	-43.955	-42.452	15.463
700	11.659	14.560	8.524	4.225	-43.924	-42.204	13.176
800	11.911	16.134	9.379	5.404	-43.914	-41.960	11.462
900	12.108	17.549	10.209	6.605	-43.925	-41.714	10.129
1000	12.272	18.833	11.008	7.825	-43.951	-41.468	9.062
1100	12.414	20.009	11.774	9.059	-43.994	-41.218	8.189
1155	12.486	20.617	12.181	9.744	-44.022	-41.078	7.773
1155	12.486	20.617	12.181	9.744	-44.022	-41.078	7.773
1200	12.541	21.045	12.506	10.307	-44.098	-40.926	7.453
1300	12.658	22.104	13.206	11.567	-44.065	-40.585	6.823
1400	12.747	23.046	13.876	12.838	-44.140	-39.237	6.281
1500	12.871	23.930	14.517	14.120	-44.222	-39.885	5.811
1600	12.970	24.764	15.131	15.412	-44.311	-39.525	5.399
1700	13.066	25.553	15.721	16.714	-44.404	-39.159	5.034
1800	13.160	26.303	16.289	18.025	-44.503	-38.791	4.710
1900	13.251	27.017	16.835	19.346	-44.605	-38.415	4.418
1950	13.296	27.352	17.100	20.010	-44.657	-38.223	4.284
1950	13.296	27.352	17.100	20.010	-44.657	-38.223	4.284
2000	13.340	27.699	17.361	20.676	-44.785	-37.940	4.146
2100	13.429	28.352	17.862	22.014	-44.934	-37.366	3.889
2200	13.516	28.976	18.350	23.361	-44.978	-36.791	3.655
2300	13.602	29.581	18.835	24.717	-44.954	-36.216	3.441
2400	13.688	30.162	19.294	26.082	-44.954	-35.632	3.245
2500	13.773	30.722	19.740	27.455	-44.957	-35.052	3.064
2600	13.857	31.264	20.173	28.836	-44.985	-34.471	2.897
2700	13.941	31.785	20.594	30.226	-44.995	-33.892	2.743
2800	14.024	32.277	21.003	31.624	-44.998	-33.308	2.600
2900	14.107	32.741	21.401	33.031	-44.995	-32.727	2.466
3000	14.190	33.170	21.782	34.446	-44.995	-32.148	2.342
3100	14.273	33.577	22.166	35.869	-44.998	-31.566	2.225
3200	14.355	33.952	22.545	37.300	-44.995	-30.984	2.116
3212	14.366	34.000	22.582	37.487	-44.995	-30.909	2.102
3212	14.366	34.000	22.582	37.487	-44.995	-30.909	2.102
3300	14.447	34.392	22.950	38.879	-44.995	-30.325	2.000
3400	14.528	34.752	23.302	40.279	-44.995	-29.741	1.903
3500	14.609	35.083	23.637	41.679	-44.995	-29.157	1.809
3550	14.650	35.270	23.798	42.879	-44.995	-28.907	1.914
3600	14.691	35.430	23.935	44.079	-44.995	-28.657	1.914
3700	14.772	35.770	24.270	45.479	-44.995	-28.073	1.801
3800	14.853	36.083	24.592	46.879	-44.995	-27.489	1.686
3900	14.934	36.375	24.905	48.279	-44.995	-26.905	1.582
4000	15.015	36.647	25.207	49.679	-44.995	-26.321	1.480
4100	15.096	36.899	25.500	51.079	-44.995	-25.737	1.382
4200	15.177	37.132	25.783	52.479	-44.995	-25.153	1.290
4300	15.258	37.347	26.057	53.879	-44.995	-24.569	1.206
4400	15.339	37.542	26.322	55.279	-44.995	-23.985	1.122
4500	15.420	37.717	26.577	56.679	-44.995	-23.401	1.038
4600	15.501	37.872	26.822	58.079	-44.995	-22.817	0.954
4700	15.582	38.007	27.057	59.479	-44.995	-22.233	0.870
4800	15.663	38.122	27.282	60.879	-44.995	-21.649	0.786
4900	15.744	38.227	27.497	62.279	-44.995	-21.065	0.702
5000	15.825	38.322	27.702	63.679	-44.995	-20.481	0.618
5100	15.906	38.407	27.897	65.079	-44.995	-19.897	0.534
5200	15.987	38.482	28.082	66.479	-44.995	-19.313	0.450
5300	16.068	38.547	28.257	67.879	-44.995	-18.729	0.366
5400	16.149	38.602	28.422	69.279	-44.995	-18.145	0.282
5500	16.230	38.647	28.577	70.679	-44.995	-17.561	0.198
5600	16.311	38.682	28.722	72.079	-44.995	-16.977	0.114
5700	16.392	38.707	28.857	73.479	-44.995	-16.393	0.030
5800	16.473	38.722	28.982	74.879	-44.995	-15.809	-0.054
5900	16.554	38.727	29.097	76.279	-44.995	-15.225	-0.138
6000	16.635	38.722	29.202	77.679	-44.995	-14.641	-0.222

31 December 1963

HLS

TITANIUM CARBIDE (TiC) (CONDENSED PHASE)

gfw = 59.911

$$\Delta H_{f298.15}^{\circ} = -44.13 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 5.79 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3213^{\circ}\text{K}$$

$$\Delta H_m = 20.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.101 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.83 + 0.80 \times 10^{-3}T - 3.58 \times 10^{-5}T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3213^{\circ}\text{K}$$

Structure

TiC has an f. c. c. structure (NaCl type) with variable homogeneity range.

Heat of Formation

Several possible values examined in the text. The calorimetric value from Humphrey¹ accepted.

Heat Capacity and Entropy

Low-temperature data from Kelley.² High-temperature data by Naylor.³

Melting and Vaporization

Heat of fusion estimated.

References

1. Humphrey, G., J. Am. Chem. Soc. 73, 2261 (1951).
2. Kelley, K. K., Ind. Eng. Chem. 36, 865 (1944).
3. Naylor, B., J. Am. Chem. Soc. 68, 370 (1946).

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid W from 0° to 3650°K,
Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K,
Solid C, Solid WC from 0° to 3058°K.

T, K	ΔH_f° cal/gfw	ΔG_f° cal/gfw	ΔH_f° cal/gfw	ΔG_f° cal/gfw	ΔH_f° kcal/gfw	ΔG_f° kcal/gfw	$\log K_p$
0							
298.15	9.869	9.500	9.500	0.000	-8.400	-8.493	6.225
300	9.910	9.561	9.500	0.018	-8.397	-8.493	6.187
400	11.419	12.646	9.910	1.094	-8.155	-8.551	4.672
500	12.228	15.288	10.729	2.280	-7.889	-8.691	3.799
600	12.762	17.567	11.683	3.551	-7.623	-8.865	3.229
700	13.165	19.566	12.669	4.828	-7.365	-9.105	2.843
800	13.499	21.346	13.645	6.161	-7.113	-9.358	2.556
900	13.793	22.954	14.541	7.526	-6.863	-9.670	2.348
1000	14.062	24.421	15.502	8.919	-6.608	-9.976	2.180
1100	14.315	25.773	16.375	10.338	-6.352	-10.347	2.056
1200	14.556	27.029	17.211	11.782	-6.090	-10.697	1.948
1300	14.789	28.204	18.012	13.249	-5.831	-11.118	1.869
1400	15.017	29.308	18.780	14.739	-5.570	-11.536	1.801
1500	15.241	30.352	19.517	16.257	-5.308	-11.971	1.744
1600	15.461	31.342	20.225	17.788	-5.045	-12.424	1.697
1700	15.679	32.286	20.907	19.345	-4.775	-12.893	1.657
1800	15.895	33.189	21.564	20.923	-4.503	-13.377	1.624
1900	16.10	34.054	22.199	22.524	-4.241	-13.876	1.596
2000	16.323	34.885	22.813	24.145	-3.968	-14.394	1.573
2100	16.535	35.687	23.407	25.788	-3.689	-14.918	1.553
2200	16.747	36.461	23.983	27.452	-3.409	-15.462	1.536
2300	16.957	37.210	24.542	29.137	-3.123	-16.018	1.522
2400	17.167	37.936	25.085	30.844	-2.834	-16.584	1.510
2500	17.377	38.641	25.613	32.571	-2.540	-17.160	1.500
2600	17.586	39.327	26.127	34.319	-2.244	-17.752	1.492
2700	17.795	39.995	26.629	36.088	-1.942	-18.355	1.486
2800	18.004	40.646	27.118	37.876	-1.636	-18.967	1.480
2900	18.212	41.281	27.595	39.689	-1.326	-19.591	1.476
3000	18.420	41.902	28.062	41.521	-1.012	-20.229	1.474
3058	18.542	42.256	28.328	42.572	-0.828	-20.606	1.472

$$\Delta H_{f298.15}^{\circ} = -8.4 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 9.5 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3058^{\circ}\text{K}$$

$$C_p^{\circ} = 12.27 + 2.06 \times 10^{-3}T - 2.68 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3058^{\circ}\text{K}$$

Structure

The structure of α -WC is simple hexagonal. A high-temperature form with face-centered cubic structure has been reported. See text for details.

Heat of Formation

The heat of formation of $-8.4 \text{ kcal gfw}^{-1}$ used is that reported by Huff and co-workers¹ who corrected the value reported by McGraw and co-workers.²

Heat Capacity and Entropy

No low-temperature heat capacity data have been reported. The value for $S_{298.15}^{\circ}$ is that estimated by Krikorian.³ The high-temperature heat capacity equation was also estimated by Krikorian.³

Melting and Vaporization

Coffman and co-workers⁴ investigated the vaporization of WC but were unable to obtain thermodynamic data. The melting point of 3058°K reported by Sara and Dolloff⁵ has been used.

References

1. Huff, G., E. Squitieri, and P. E. Snyder, JACS 70, 3380 (1948).
2. McGraw, L. D., H. Settz, and P. E. Snyder, JACS 69, 329 (1947).
3. Krikorian, O., Estimation of High-Temperature Heat Capacities of Carbides, UCRL 6785 (1962).
4. Coffman, J. A., G. M. Kibler, T. F. Lyon, and B. D. Acchione, WADD-TR-60-646, Part II (1963).
5. Sara, R. V. and R. T. Dolloff, WADD-TR-60-143, Part III (1962).

TUNGSTEN CARBIDE (WC)

(CONDENSED PHASE)

GFW = 195.871

SUMMARY OF UNCERTAINTY ESTIMATES

T, K	C_p	S_T	$-(H_T - H_{298}^{\circ})/T$	H_T	H_{fT}°	Kcal gfw	ΔH_f	ΔH_f	Log K _p
298.15	± 1.000	± 0.500	± 0.500	± 0.000	± 0.200				
500	± 1.000	± 1.017	± 0.613	± 0.202					
1000	± 1.000	± 1.710	± 1.008	± 0.702					
1500	± 1.000	± 2.116	± 1.314	± 1.202					
2000	± 1.000	± 2.403	± 1.552	± 1.702					
2500	± 1.000	± 2.626	± 1.746	± 2.202					
3000	± 1.000	± 2.809	± 1.908	± 2.702					
3058	± 1.000	± 2.828	± 1.925	± 2.760					

TABLE 119

DIUNGSTEN CARBIDE

CONDENSED PHASE

CW₂

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid W from 0° to 3650°K,
 Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K,
 Solid C, Solid W₂C from 0° to 3068°K

T °K	ΔH_f° (KJ/gm)	ΔG_f° (KJ/gm)	ΔH_f° (KJ/gm)	ΔG_f° (KJ/gm)	ΔH_f° (KJ/gm)	ΔG_f° (KJ/gm)	$\log K_p$
0							
298.15	18.320	19.500	19.500	0.000	-11.000	-11.740	8.605
300	18.373	19.613	19.500	0.034	-10.992	-11.744	8.555
400	20.325	25.201	20.243	1.741	-10.467	-12.054	8.580
500	21.368	29.858	21.719	4.070	-9.899	-12.535	8.479
600	22.053	33.818	23.414	6.243	-9.318	-13.095	8.369
700	22.570	37.258	25.151	8.475	-8.739	-13.795	8.250
800	22.996	40.301	26.858	10.754	-8.163	-14.529	8.129
900	23.370	43.031	28.506	13.073	-7.587	-15.294	7.998
1000	23.712	45.511	30.084	15.427	-7.003	-16.092	7.852
1100	24.032	47.787	31.592	17.814	-6.419	-16.920	7.692
1200	24.338	49.891	33.030	20.233	-5.828	-17.774	7.518
1300	24.634	51.851	34.403	22.682	-5.246	-18.650	7.332
1400	24.922	53.687	35.716	25.160	-4.670	-19.548	7.135
1500	25.205	55.416	36.972	27.666	-4.102	-20.467	6.928
1600	25.484	57.052	38.176	30.200	-3.544	-21.405	6.712
1700	25.760	58.605	39.333	32.763	-2.989	-22.362	6.488
1800	26.033	60.085	40.445	35.352	-2.445	-23.337	6.258
1900	26.304	61.500	41.516	37.969	-1.904	-24.329	6.024
2000	26.573	62.856	42.549	40.613	-1.371	-25.337	5.788
2100	26.841	64.159	43.548	43.284	-0.841	-26.360	5.550
2200	27.108	65.414	44.513	45.981	-0.321	-27.397	5.310
2300	27.374	66.625	45.448	48.705	0.197	-28.448	5.068
2400	27.640	67.795	46.355	51.456	0.707	-29.512	4.825
2500	27.904	68.929	47.236	54.233	1.214	-30.588	4.582
2600	28.169	70.028	48.091	57.037	1.713	-31.675	4.340
2700	28.437	71.096	48.924	59.867	2.209	-32.773	4.098
2800	28.696	72.135	49.734	62.723	2.698	-33.880	3.855
2900	28.959	73.147	50.524	65.606	3.183	-34.995	3.611
3000	29.221	74.133	51.299	68.515	3.661	-36.116	3.367
3068	29.400	74.790	51.808	70.508	3.984	-36.186	3.076

15 June 1963

DFA

$$\Delta H_f^{\circ}{}_{298.15} = -11.0 \text{ kcal gfw}^{-1}$$

$$S^{\circ}{}_{298.15} = 19.5 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3068^{\circ}\text{K}$$

$$C_p^{\circ} = 21.45 + 2.60 \times 10^{-3}T - 3.48 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3068^{\circ}\text{K}$$

Structure

The crystal structure of W₂C is simple hexagonal. Lattice parameters are given in the text.

Heat of Formation

The heat of formation of -11.0 kcal gfw⁻¹ estimated by Krikorian¹ has been used since no experimental values have been reported.

Heat Capacity and Entropy

No low temperature heat capacity data have been reported. The entropy at 298.15°K is that estimated by Krikorian.² The high-temperature heat capacity equation is that estimated by Krikorian.²

Melting and Vaporization

No vaporization data have been reported. The melting point of 3068°K reported by Sara and Dolloff³ has been adopted.

References

1. Krikorian, O., High Temperature Studies, UCRL-2888 (April 1955).
2. Krikorian, O., Estimation of High Temperature Heat Capacities of Carbides, UCRL-6785 (1962).
3. Sara, R. V. and R. T. Dolloff, WADD-TR-60-143, Part III (1962).

DITUNGSTEN CARBIDE (W₂C)

(CONDENSED PHASE)

GFW = 379.731

SUMMARY OF UNCERTAINTY ESTIMATES

T, K	C _p	S _T	ΔH _f	ΔH _f - ΔH ₂₉₈	ΔH _f	ΔH _f	Log K _p
298.15	± 1.400	± 1.000	± 1.000	± 0.000	± 4.000		
500	± 1.400	± 1.724	± 1.157	± 0.285			
1000	± 1.400	± 2.694	± 1.712	± 0.983			
1500	± 1.400	± 3.262	± 2.140	± 1.683			
2000	± 1.400	± 3.665	± 2.473	± 2.383			
2500	± 1.400	± 3.977	± 2.744	± 3.083			
3000	± 1.400	± 4.232	± 2.971	± 3.783			
3068	± 1.400	± 4.264	± 3.000	± 3.878			

TABLE 120

ZIRCONIUM CARBIDE

CONDENSED PHASE

CZr

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p Solid Zr from 0° to 2125°K,
Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K, Solid C,
Solid ZrC from 0° to 3693°K, Liquid ZrC from 3693° to 6000°K.

T, °K	C_p	$\frac{cal}{^\circ K \text{ gfw}}$ S_T	$\frac{cal}{^\circ K \text{ gfw}}$ $-(F_T - H_{298}/T)$	$\frac{cal}{^\circ K \text{ gfw}}$ $H_T - H_{298}$	$\frac{Kcal}{gfw}$ ΔH_f°	$\frac{Kcal}{gfw}$ ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.401	-47.836	-47.836	INFINITE
298.15	9.058	7.964	7.964	0.000	-48.000	-47.199	34.596
300	9.098	8.020	7.964	0.017	-47.998	-47.194	34.380
400	10.588	10.868	8.342	1.010	-47.882	-46.941	25.647
500	11.595	14.324	9.099	2.113	-47.771	-46.722	20.421
600	11.935	15.452	9.785	3.281	-47.682	-46.521	16.944
700	12.346	17.324	10.702	4.495	-47.616	-46.333	14.465
800	12.694	18.996	11.911	5.748	-47.564	-46.154	12.608
900	13.000	20.509	12.695	7.033	-47.525	-45.979	11.165
1000	13.282	21.894	13.547	8.347	-47.493	-45.810	10.011
1100	13.548	23.172	14.364	9.687	-47.466	-45.644	9.068
1135	13.672	23.588	14.638	10.167	-47.454	-45.580	8.776
1135	13.672	23.588	14.638	10.167	-48.369	-45.580	8.776
1200	13.803	24.362	15.148	11.056	-48.344	-45.426	8.273
1300	14.051	26.477	15.900	12.449	-48.290	-45.184	7.596
1400	14.293	28.627	16.622	13.866	-48.211	-44.948	7.016
1500	14.530	27.621	17.316	15.308	-48.111	-44.718	6.515
1600	14.765	28.466	17.984	16.772	-48.007	-44.494	6.077
1700	14.998	29.364	18.627	18.261	-47.902	-44.275	5.692
1800	15.228	30.212	19.248	19.772	-47.796	-44.067	5.350
1900	15.457	31.062	19.848	21.306	-47.698	-43.866	5.045
2000	15.684	31.860	20.429	22.863	-47.616	-43.676	4.772
2100	15.912	32.631	20.992	24.443	-47.513	-43.493	4.526
2125	15.968	32.817	21.128	24.884	-47.416	-43.444	4.468
2125	15.968	32.817	21.128	24.884	-52.016	-43.444	4.468
2200	16.137	33.377	21.548	26.045	-51.899	-43.147	4.286
2300	16.363	34.099	22.068	27.670	-51.666	-42.756	4.063
2400	16.587	34.800	22.584	29.318	-51.413	-42.372	3.858
2500	16.812	35.482	23.087	30.988	-51.139	-42.003	3.672
2600	17.036	36.147	23.576	32.680	-50.846	-41.640	3.500
2700	17.254	36.793	24.054	34.395	-50.531	-41.296	3.343
2800	17.468	37.424	24.520	36.132	-50.195	-40.958	3.197
2900	17.676	38.042	24.976	37.892	-49.839	-40.634	3.062
3000	17.878	38.646	25.421	39.673	-49.463	-40.323	2.937
3100	18.151	39.237	25.857	41.477	-49.061	-40.024	2.822
3200	18.373	39.817	26.285	43.303	-48.644	-39.741	2.714
3300	18.595	40.386	26.703	45.152	-48.208	-39.469	2.614
3400	18.817	40.944	27.114	47.022	-47.749	-39.211	2.520
3500	19.039	41.493	27.517	48.915	-47.269	-38.967	2.433
3600	19.261	42.032	27.913	50.830	-46.768	-38.737	2.352
3693	19.487	42.526	28.275	52.611	-46.284	-38.539	2.281
3693	19.000	47.942	28.275	72.631	-26.284	-38.539	2.281
3700	19.000	47.978	28.312	72.764	-26.250	-38.558	2.277
3800	19.000	48.484	28.876	74.664	-25.767	-38.899	2.237
3900	19.000	48.978	29.346	76.564	-25.286	-39.248	2.199
4000	19.000	49.459	29.843	78.464	-24.804	-39.612	2.164
4100	19.000	49.928	30.327	80.364	-24.328	-39.989	2.131
4200	19.000	50.386	30.799	82.264	-23.852	-40.377	2.101
4300	19.000	50.833	31.260	84.164	-23.478	-40.776	2.072
4400	19.000	51.270	31.710	86.064	-22.905	-41.189	2.046
4500	19.000	51.697	32.149	87.964	-22.434	-41.605	2.021
4600	19.000	52.114	32.579	89.864	-21.964	-42.038	1.997
4644.05	19.000	52.294	32.764	90.701	-21.758	-42.227	1.987
4644.05	19.000	52.294	32.764	90.701	-157.212	-42.227	1.987
4700	19.000	52.523	32.999	91.764	-157.005	-40.847	1.899
4800	19.000	52.923	33.410	93.664	-156.641	-38.381	1.747
4900	19.000	53.315	33.817	95.564	-156.284	-35.917	1.602
5000	19.000	53.699	34.206	97.464	-155.933	-33.465	1.463
5100	19.000	54.075	34.592	99.364	-155.590	-31.022	1.329
5200	19.000	54.444	34.970	101.264	-155.253	-28.578	1.201
5300	19.000	54.808	35.341	103.164	-154.922	-26.148	1.078
5400	19.000	55.161	35.705	105.064	-154.596	-23.722	0.960
5500	19.000	55.510	36.062	106.964	-154.276	-21.303	0.846
5600	19.000	55.852	36.412	108.864	-153.961	-18.886	0.737
5700	19.000	56.188	36.756	110.764	-153.652	-16.473	0.632
5800	19.000	56.519	37.094	112.664	-153.346	-14.070	0.530
5900	19.000	56.844	37.426	114.564	-153.045	-11.674	0.432
6000	19.000	57.164	37.752	116.464	-152.748	-9.276	0.338

15 March 1963

HLS

$$\Delta H_{f298.15}^{\circ} = -48.0 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 7.964 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3693^{\circ}\text{K}$$

$$\Delta H_m = 20.0 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.401 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.336 + 2.207 \times 10^{-3}T - 2.610 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3693^{\circ}\text{K}$$

Structure

ZrC has a cubic, NaCl (B1) type structure.

Heat of Formation

Choice based on vaporization from Knudsen cell by Pollock,¹ and Langmuir vaporization by Pollock and Coffman et al.²

Heat Capacity and Entropy

Low-temperature data by Westrum³ and Westrum and Feick.⁴ High-temperature data based on estimates of Krikorian⁵ joined low-temperature data. It agreed with available experimental data of Margrave⁶ and Southern Res. Inst.⁷

Melting and Vaporization

Melting temperature from Dolloff and Sara.⁸ Heat of melting estimated.

References

1. Pollock, B. D., J. Phys. Chem. 65, 731 (1961).
2. Coffman, J. A. et al. WADD TR-60-646, Pt. II (1961).
3. Westrum, E., in A. D. Little Third Semiannual Prog. Rept., Contract AF33(616)-7472 (August 1962).
4. Westrum, E. and G. Feick, Manuscript courtesy of E. Westrum.
5. Krikorian, O. H., UCRL-6785 (6 February 1962).
6. Margrave, J., in A. D. Little Rept., ASD-TDR-62-204, Pt. 1, AD 277500 (April 1962).
7. Neel, D. S. et al, Southern Res. Inst., WADD TR-60-924 (February 1962).
8. Dolloff, R. T. and R. V. Sara, Nat. Carbon Co. Prog. Rept. No. 3, Contract AF33(616)-6286 (10 December 1962).

ZIRCONIUM CARBIDE (ZrC)

(CONDENSED PHASE)

gfw = 103.231

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	S_T	$H_T - H_{298.15}$	$H_T - H_{298}$	ΔH_f	ΔH_v	$T \times K_f$
298.15	± 0.300	± 0.050	± 0.050	± 0.000	± 5.000		
1000	± 0.500	± 0.413	± 0.262	± 0.211			
2000	± 0.850	± 0.898	± 0.443	± 0.911			
3000	± 1.000	± 1.304	± 0.667	± 1.911			
3693	± 1.000	± 1.512	± 0.807	± 2.604			
3693	± 1.000	± 2.865	± 0.807	± 7.604			
4000	± 2.000	± 3.025	± 0.971	± 8.218			
5000	± 2.000	± 3.471	± 1.428	± 10.218			
6000	± 2.000	± 3.836	± 1.800	± 12.218			

TABLE 121

DIATOMIC CARBON

IDEAL MOLECULAR GAS

C₂Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p
Solid Graphite from 0° to 6000°K

T, °K	$\left(\frac{1}{T} \int_0^T \frac{C_p}{T^2} dT \right)$	$\left(\frac{1}{T} \int_0^T \frac{C_p}{T} dT \right)$	$\left(\int_0^T \frac{C_p}{T^2} dT \right)$	$\left(\int_0^T \frac{C_p}{T} dT \right)$	ΔH_f°	ΔF_f°	Log K _p
0	0.000	0.000	INFINITE	-2.528	196.636	196.636	INFINITE
298.15	10.312	47.630	47.630	0.000	198.660	185.270	-135.800
300	10.302	47.634	47.630	0.019	198.671	185.186	-134.902
400	9.478	50.548	44.025	1.009	199.169	180.610	-98.676
500	8.878	52.552	48.744	1.924	199.446	175.934	-76.897
600	8.606	54.182	49.523	2.796	199.562	171.218	-62.363
700	8.516	55.501	50.285	3.651	199.567	166.493	-51.979
800	8.512	56.637	51.010	4.502	199.500	161.770	-44.191
900	8.546	57.641	51.692	5.355	199.379	157.062	-38.138
1000	8.599	58.544	52.333	6.212	199.224	152.367	-33.298
1100	8.659	59.366	52.935	7.075	199.041	147.692	-29.342
1200	8.724	60.123	53.503	7.944	198.838	143.032	-26.048
1300	8.791	60.824	54.040	8.819	198.615	138.389	-23.264
1400	8.861	61.478	54.548	9.702	198.386	133.769	-20.881
1500	8.932	62.092	55.030	10.592	198.148	129.161	-18.818
1600	9.005	62.670	55.490	11.489	197.905	124.568	-17.014
1700	9.078	63.218	55.929	12.393	197.661	119.955	-15.426
1800	9.151	63.739	56.348	13.304	197.414	115.334	-14.015
1900	9.225	64.236	56.750	14.223	197.169	110.886	-12.754
2000	9.297	64.711	57.137	15.147	196.927	106.546	-11.620
2100	9.369	65.167	57.508	16.082	196.684	101.825	-10.597
2200	9.439	65.604	57.866	17.023	196.443	97.317	-9.667
2300	9.508	66.025	58.212	17.970	196.206	92.807	-8.818
2400	9.574	66.431	58.546	18.924	195.970	88.325	-8.043
2500	9.639	66.823	58.869	19.885	195.739	83.843	-7.329
2600	9.701	67.203	59.183	20.852	195.508	79.373	-6.672
2700	9.761	67.570	59.487	21.825	195.281	74.906	-6.063
2800	9.818	67.926	59.782	22.804	195.058	70.451	-5.499
2900	9.873	68.271	60.069	23.788	194.834	66.007	-4.974
3000	9.925	68.607	60.348	24.778	194.614	61.563	-4.485
3100	9.975	68.933	60.619	25.772	194.397	57.136	-4.028
3200	10.022	69.251	60.884	26.773	194.181	52.714	-3.600
3300	10.067	69.560	61.143	27.778	193.966	48.289	-3.198
3400	10.110	69.861	61.395	28.787	193.753	43.886	-2.821
3500	10.151	70.154	61.641	29.800	193.540	39.473	-2.465
3600	10.189	70.442	61.881	30.817	193.329	35.082	-2.130
3700	10.226	70.721	62.117	31.838	193.119	30.684	-1.812
3800	10.260	70.995	62.347	32.862	192.910	26.296	-1.512
3900	10.293	71.262	62.572	33.890	192.700	21.910	-1.228
4000	10.323	71.523	62.793	34.921	192.490	17.536	-0.958
4100	10.353	71.778	63.009	35.955	192.279	13.161	-0.702
4200	10.380	72.026	63.221	36.991	192.067	8.803	-0.458
4300	10.406	72.273	63.428	38.021	191.855	4.438	-0.226
4400	10.431	72.513	63.631	39.053	191.643	0.075	-0.004
4500	10.454	72.747	63.830	40.087	191.429	-4.275	0.208
4600	10.476	72.978	64.024	41.124	191.214	-8.620	0.410
4700	10.497	73.203	64.212	42.162	191.000	-12.958	0.603
4800	10.517	73.422	64.411	43.203	190.789	-17.299	0.788
4900	10.536	73.642	64.608	44.246	190.580	-21.634	0.965
5000	10.554	73.854	64.781	45.291	190.370	-25.965	1.145
5100	10.571	74.061	64.961	46.337	190.161	-30.284	1.298
5200	10.587	74.260	65.139	47.385	189.957	-34.600	1.454
5300	10.603	74.472	65.311	48.434	189.759	-38.923	1.605
5400	10.618	74.671	65.485	49.486	189.568	-43.227	1.749
5500	10.633	74.866	65.654	50.539	189.373	-47.542	1.889
5600	10.647	75.056	65.820	51.593	189.185	-51.850	2.023
5700	10.661	75.247	65.984	52.649	188.997	-56.149	2.152
5800	10.674	75.433	66.146	53.706	188.804	-60.442	2.278
5900	10.687	75.618	66.305	54.764	188.618	-64.715	2.398
6000	10.700	75.796	66.462	55.824	188.428	-68.968	2.514

15 September 1962

CHW

DIATOMIC CARBON (C₂) (IDEAL MOLECULAR GAS)

gfw = 24.022

$$\Delta H^\circ_{f0} = 196.636 \text{ Kcal gfw}^{-1}$$

$$\Delta H^\circ_{f298.15} = 198.660 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $1\Sigma_g^+$

$$S^\circ_{298.15} = 47.630 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 2.528 \text{ Kcal gfw}^{-1}$$

Spectroscopic constants from Clementi,¹ for 13 electronic states were used. See volume 1, this study (section IVA4c) for details.

Heat of Formation

Based on data of Drowart, et al².

Heat Capacity and Entropy

Calculated on diatomic gas computer program.

References

1. Clementi, E., *Astrophys. J.* 133, 303 (1961).
2. Drowart, J., et al, *J. Chem. Phys.* 31, 1131 (1959).

TABLE 122

TRIMOLYBDENUM DICARBIDE

CONDENSED PHASE

 C_2Mo_3

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
 Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K, Solid C;
 Solid Mo_3C_2 from 0° to 2923°K.

T, °K	cal/°K gfw			Kcal/gfw			$\log K_p$
	C_p	S_f°	$-(H_f^\circ - H_{298}^\circ)/T$	$H_f^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
0	---	---	---	---	---	---	---
298.15	24.639	23.710	23.710	0.000	-13.970	-14.120	10.350
300	24.741	23.863	23.710	0.046	-13.965	-14.121	10.286
400	28.516	31.564	24.735	2.732	-13.523	-14.236	7.778
500	30.539	38.164	26.778	5.693	-13.024	-14.464	6.322
600	31.873	43.856	29.161	8.817	-12.522	-14.808	5.393
700	32.882	48.848	31.624	12.057	-12.037	-15.226	4.754
800	33.717	53.295	34.060	15.388	-11.544	-15.716	4.293
900	34.452	57.309	36.424	18.797	-11.059	-16.266	3.950
1000	35.123	60.975	38.698	22.276	-10.572	-16.871	3.687
1100	35.754	64.352	40.879	25.820	-10.114	-17.525	3.482
1200	36.357	67.489	42.967	29.426	-9.680	-18.216	3.317
1300	36.940	70.422	44.968	33.091	-9.273	-18.946	3.185
1400	37.509	73.181	46.885	36.814	-8.882	-19.704	3.076
1500	38.068	75.788	48.726	40.593	-8.481	-20.492	2.986
1600	38.618	78.262	50.495	44.427	-8.127	-21.300	2.909
1700	39.163	80.620	52.199	48.316	-7.807	-22.138	2.846
1800	39.702	82.874	53.841	52.259	-7.524	-22.988	2.791
1900	40.238	85.034	55.426	56.256	-7.283	-23.854	2.744
2000	40.770	87.112	56.959	60.307	-7.087	-24.736	2.703
2100	41.300	89.114	58.442	64.410	-6.942	-25.619	2.666
2200	41.828	91.047	59.881	68.567	-6.856	-26.510	2.633
2300	42.354	92.918	61.277	72.776	-6.828	-27.407	2.604
2400	42.879	94.732	62.633	77.038	-6.867	-28.298	2.577
2500	43.403	96.493	63.952	81.352	-6.979	-29.182	2.551
2600	43.925	98.206	65.237	85.718	-7.171	-30.074	2.528
2700	44.447	99.873	66.489	90.137	-7.441	-30.950	2.505
2800	44.968	101.499	67.711	94.608	-7.796	-31.809	2.483
2890	45.436	102.929	68.785	98.676	-8.198	-32.573	2.463
2890	45.436	102.929	68.785	98.676	-28.148	-32.573	2.463
2900	45.488	103.086	68.903	99.130	-28.116	-32.582	2.455
2923	45.607	103.446	69.174	100.178	-28.036	-32.607	2.438

15 September 1961

DFA

TRIMOLYBDENUM DICARBIDE (Mo_3C_2) (CONDENSED PHASE) gfw = 311.87

$$\Delta H_{f298.15}^\circ = -13.97 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^\circ = 23.71 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2923^\circ\text{K}$$

$$C_p^\circ = 30.65 + (5.14 \times 10^{-3}) T - (6.71 \times 10^{-5}) T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^\circ\text{K} \leq T \leq 2923^\circ\text{K}$$

Structure

Mo_3C_2 has a hexagonal structure ($a = 3.00 \text{ \AA}$ $c = 14.61 \text{ \AA}$) with a high-temperature cubic form ($a = 4.26 \text{ \AA}$).

Heat of Formation

The heat of formation was calculated from the free-energy functions and the free energy at 1700°K . The free energy at 1700°K was calculated from the disproportionation reaction of Mo_3C_2 to Mo_2C and C.

Heat Capacity and Entropy

The heat-capacity equation was estimated by Krikorian². The entropy was calculated from an estimated $S_{298.15}^\circ$, Mo_3C_2 of 0.5 e. u.

Melting and Vaporization

The melting temperature was determined by Nowotny.¹

References

1. Nowotny, H., E. Parthe, R. Kieffer and F. Benesovsky, Monat Chem, 85, 255 (1954).
2. Krikorian, O., Estimation of High Temperature Heat Capacities of Carbides, UCRL-6785 (1962).

TABLE 123

THORIUM DICARBIDE

CONDENSED PHASE

 C_2Th

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Th from 0° to 2928°K,
 Liquid Th from 2928° to 5060°K, Gaseous Th from 5060° to 6000°K,
 Solid C, Solid ThC_2 from 0° to 2928°K.

T, °K	C_f	ΔH_f° kcal	ΔH_f° kcal	ΔH_f° kcal	ΔH_f° kcal	ΔF_f° kcal	$\log K_p$
0							
298.15	10.249	15.100	15.100	0.000	-46.600	-46.487	34.074
300	10.289	15.164	15.100	0.019	-46.601	-46.487	33.864
400	11.762	18.352	15.525	1.131	-46.648	-46.442	25.374
500	12.552	21.068	16.369	2.350	-46.758	-46.379	20.271
600	13.072	23.406	17.352	3.632	-46.950	-46.288	16.860
700	13.465	25.451	18.366	4.960	-47.215	-46.157	14.410
800	13.791	27.271	19.367	6.323	-47.538	-45.985	12.562
900	14.077	28.917	20.338	7.717	-47.912	-45.768	11.114
1000	14.336	30.409	21.271	9.138	-48.324	-45.509	9.946
1100	14.583	31.767	22.165	10.584	-48.778	-45.206	8.981
1200	14.818	33.066	23.021	12.054	-49.275	-44.860	8.170
1300	15.041	34.261	23.840	13.547	-49.823	-44.469	7.476
1400	15.266	35.384	24.625	15.063	-50.420	-44.034	6.874
1500	15.484	36.445	25.378	16.600	-51.082	-43.558	6.346
1600	15.698	37.451	26.102	18.159	-51.817	-43.032	5.878
1653	15.768	37.772	26.334	18.679	-52.075	-42.846	5.734
1683	15.768	37.772	26.334	18.679	-52.729	-42.846	5.734
1700	15.909	38.409	26.798	19.740	-53.175	-42.432	5.455
1800	16.119	39.345	27.468	21.341	-53.832	-41.780	5.072
1900	16.327	40.202	28.116	22.964	-54.473	-41.094	4.727
2000	16.534	41.044	28.741	24.607	-55.100	-40.374	4.412
2028	16.592	41.275	28.913	25.070	-55.273	-40.167	4.328
2028	16.592	41.275	28.913	25.070	-59.126	-40.167	4.328
2100	16.741	41.856	29.346	26.270	-59.564	-39.483	4.109
2200	16.945	42.640	29.933	27.955	-60.161	-38.512	3.826
2300	17.150	43.397	30.502	29.660	-60.740	-37.520	3.565
2400	17.357	44.132	31.055	31.385	-61.305	-36.496	3.323
2500	17.568	44.844	31.592	33.130	-61.852	-35.450	3.099
2600	17.761	45.537	32.115	34.896	-62.384	-34.383	2.890
2700	17.964	46.211	32.625	36.683	-62.897	-33.300	2.695
2800	18.167	46.865	33.122	38.489	-63.393	-32.191	2.513
2900	18.367	47.505	33.607	40.316	-63.874	-31.070	2.341
2928	18.421	47.686	33.741	40.831	-64.005	-30.754	2.295

15 September 1963

MBP

THORIUM DICARBIDE (ThC₂)

(CONDENSED PHASE)

gfw = 256.072

$$\Delta H_{f298.15}^{\circ} = -46.6 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 15.1 \pm 3.0 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2928 \pm 25^{\circ}\text{K}$$

$$C_p^{\circ} = (12.60 \pm 1.16) + (2.00 \pm 0.18) 10^{-3} T - (2.63 \pm 0.20) \times 10^{-5} T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298^{\circ}\text{K} \leq T \leq 2928^{\circ}\text{K}$$

Heat of Formation

Computed indirectly; see volume 1, this study (section IVB29. 2).

Heat Capacity and EntropyEmpirical equation developed by Krikorian.¹Melting and VaporizationMelting point from Wilhelm and Chiotti.²Vaporization of Jackson and co-workers.³References

1. Krikorian, O. H., UCRL 2888
2. Wilhelm, H., and Chiotti, P., Trans. Am. Soc. Met. 42, 1295 (1950).
3. Jackson, D. D., G. W. Barton, O. H. Krikorian, and R. S. Newbury, UCRL 6701 (1962).

THORIUM DICARBIDE (ThC₂)

(CONDENSED PHASE)

GFW = 256.072

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(T \int_1^{\infty} \frac{H_T^{\circ} - H_{298}^{\circ}}{T^2} dT)$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔG_f°	Log K _p
298.15	± 0.989	± 3.000	± 3.000	± 0.000			
500	± 1.170	± 3.564	± 3.120	± 0.222			
1000	± 1.320	± 4.428	± 3.579	± 0.849			
1500	± 1.421	± 4.982	± 3.959	± 1.535			
2000	± 1.515	± 5.404	± 4.270	± 2.269			
2500	± 1.607	± 5.752	± 4.532	± 3.050			
2928	± 1.685	± 6.012	± 4.730	± 3.754			

TABLE 124

THORIUM DICARBIDE

IDEAL MOLECULAR GAS

 C_2Th

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Th from 0° to 2028°K,
 Liquid Th from 2028° to 5060°K, Gaseous Th from 5060° to 6000°K, Solid C; Gaseous ThC_2 .

T, °K	C_p	C_p	$(H_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-2.469	162.791	162.791	INFINITE
298.15	10.255	61.136	61.136	0.000	163.200	149.587	-109.645
300	10.271	61.199	61.136	0.019	163.199	149.503	-108.907
400	10.876	64.245	61.547	1.079	163.100	144.949	-79.193
500	11.312	66.720	62.342	2.189	162.881	140.434	-61.381
600	11.731	68.819	63.251	3.341	162.559	135.973	-49.526
700	12.159	70.659	64.180	4.535	162.160	131.573	-41.077
800	12.588	72.311	65.095	5.773	161.712	127.233	-34.757
900	13.003	73.818	65.982	7.053	161.224	122.952	-29.855
1000	13.389	75.208	66.836	8.372	160.710	118.726	-25.946
1100	13.736	76.501	67.656	9.729	160.167	114.555	-22.759
1200	14.040	77.710	68.444	11.118	159.589	110.432	-20.112
1300	14.296	78.844	69.201	12.535	158.965	106.361	-17.880
1400	14.505	79.911	69.928	13.976	158.293	102.342	-15.976
1500	14.668	80.918	70.628	15.435	157.553	98.367	-14.331
1600	14.790	81.869	71.301	16.908	156.732	94.450	-12.901
1633	14.822	82.171	71.517	17.397	155.442	93.170	-12.469
1633	14.822	82.171	71.517	17.397	155.789	93.170	-12.469
1700	14.875	82.768	71.949	18.392	155.277	90.612	-11.648
1800	14.928	83.620	72.574	19.882	154.509	86.830	-10.542
1900	14.953	84.428	73.177	21.376	153.739	83.090	-9.557
2000	14.956	85.195	73.759	22.872	152.965	79.390	-8.675
2028	14.953	85.403	73.918	23.291	152.748	78.363	-8.444
2028	14.953	85.403	73.918	23.291	148.895	78.363	-8.444
2100	14.941	85.924	74.321	24.367	148.333	75.869	-7.895
2200	14.912	86.614	74.864	25.860	147.544	72.439	-7.196
2300	14.871	87.281	75.390	27.349	146.749	69.038	-6.560
2400	14.823	87.913	75.898	28.834	145.944	65.681	-5.981
2500	14.768	88.517	76.391	30.313	145.131	62.352	-5.451
2600	14.710	89.095	76.869	31.787	144.307	59.057	-4.964
2700	14.650	89.649	77.332	33.255	143.475	55.791	-4.516
2800	14.588	90.180	77.781	34.717	142.635	52.564	-4.103
2900	14.526	90.691	78.218	36.173	141.783	49.358	-3.720
3000	14.464	91.183	78.642	37.622	140.922	46.185	-3.364
3100	14.403	91.656	79.054	39.066	140.054	43.041	-3.034
3200	14.344	92.112	79.455	40.503	139.175	39.930	-2.727
3300	14.286	92.553	79.845	41.934	138.286	36.836	-2.439
3400	14.231	92.978	80.225	43.360	137.390	33.782	-2.171
3500	14.177	93.390	80.596	44.781	136.485	30.743	-1.920
3600	14.126	93.789	80.957	46.196	135.572	27.736	-1.684
3700	14.077	94.175	81.309	47.606	134.650	24.753	-1.462
3800	14.030	94.550	81.652	49.011	133.721	21.794	-1.253
3900	13.985	94.914	81.988	50.412	132.784	18.857	-1.057
4000	13.942	95.267	82.315	51.808	131.840	15.952	-0.872
4100	13.901	95.611	82.635	53.200	130.888	13.066	-0.696
4200	13.862	95.946	82.948	54.589	129.929	10.207	-0.531
4300	13.825	96.271	83.254	55.973	128.961	7.364	-0.374
4400	13.790	96.588	83.554	57.354	127.988	4.545	-0.226
4500	13.757	96.898	83.847	58.731	127.007	1.754	-0.085
4600	13.725	97.200	84.134	60.105	126.019	-1.020	0.048
4700	13.694	97.495	84.415	61.476	125.026	-3.772	0.175
4800	13.666	97.783	84.691	62.844	124.024	-6.499	0.296
4900	13.638	98.065	84.961	64.209	123.017	-9.206	0.411
5000	13.612	98.340	85.225	65.572	122.004	-11.895	0.520
5060.26	13.597	98.503	85.383	66.392	121.389	-13.504	0.583
5060.26	13.597	98.503	85.383	66.392	-1.376	-13.504	0.583
5100	13.587	98.609	85.485	66.932	-1.717	13.597	0.583
5200	13.563	98.873	85.740	68.289	-2.581	-13.824	0.581
5300	13.541	99.131	85.990	69.644	-3.455	-14.027	0.578
5400	13.519	99.384	86.236	70.997	-4.339	-14.217	0.575
5500	13.499	99.632	86.477	72.348	-5.234	-14.395	0.572
5600	13.479	99.875	86.714	73.697	-6.136	-14.555	0.568
5700	13.461	100.113	86.947	75.044	-7.049	-14.691	0.563
5800	13.443	100.347	87.176	76.389	-7.970	-14.814	0.558
5900	13.426	100.577	87.402	77.733	-8.899	-14.933	0.553
6000	13.410	100.802	87.623	79.075	-9.835	-15.050	0.547

15 September 1963

MBP

THORIUM DICARBIDE (ThC₂) (IDEAL MOLECULAR GAS) gfw = 256.072

$$\Delta H_{f0}^{\circ} = 162.791 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 163.2 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.469 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 61.136 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Vibrational Levels and Multiplicities

ω , cm⁻¹

ω , cm⁻¹

592

1756

399

Bond lengths and angles:

Th-C distance = 1.90 Å

C-C distance = 1.31 Å

Electronic Contribution First ten levels for Th III¹

Computed from vaporization data of Jackson & co-workers² by third law method

Heat Capacity and Entropy

Computed using the spectroscopic data given above.

References

1. De Bruin, T. L., P. F. Klinkenbert, and P. Schuurmans, Zeit. Phys. 118,58 (1941).
2. Jackson, D. D., G. W. Barton, O. J. Krikorian, and R. S. Newbury, UCRL 6701 (April 1962).

TABLE 125

TRIATOMIC CARBON

IDEAL MOLECULAR GAS

C₃Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$
Solid Graphite from 0° to 6000°K.

T, °K	$\int_0^T \frac{C_p}{T} dT$	$\int_0^T \frac{C_p}{T^2} dT$	$\frac{H_T - H_{298}}{T}$	$\frac{H_T - H_{298}}{T}$	$\frac{Kcal}{gfw}$ ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.319	187.377	187.377	INFINITE
298.15	9.388	50.689	50.689	0.000	188.940	175.043	-128.304
300	9.407	50.748	50.690	0.017	188.945	174.956	-127.449
400	10.311	53.583	51.070	1.005	189.195	170.252	-93.017
500	11.030	55.964	51.817	2.073	189.306	166.001	-72.555
600	11.623	58.029	52.684	3.207	189.306	160.737	-58.546
700	12.115	59.859	53.581	4.395	189.219	155.982	-48.697
800	12.524	61.504	54.470	5.627	189.074	151.242	-41.315
900	12.862	62.999	55.336	6.897	188.883	146.525	-35.579
1000	13.141	64.369	56.172	8.198	188.666	141.828	-30.995
1100	13.373	65.633	56.975	9.524	188.423	137.158	-27.249
1200	13.566	66.805	57.746	10.871	188.162	132.508	-24.132
1300	13.727	67.898	58.485	12.236	187.880	127.881	-21.498
1400	13.862	68.920	59.195	13.615	187.591	123.278	-19.244
1500	13.977	69.880	59.875	15.008	187.292	118.694	-17.293
1600	14.074	70.786	60.529	16.410	186.984	114.131	-15.589
1700	14.158	71.641	61.158	17.822	186.674	109.589	-14.088
1800	14.230	72.453	61.763	19.241	186.356	105.064	-12.756
1900	14.292	73.224	62.346	20.668	186.037	100.556	-11.566
2000	14.347	73.958	62.908	22.100	185.714	96.064	-10.497
2100	14.394	74.659	63.451	23.537	185.390	91.589	-9.531
2200	14.436	75.330	63.976	24.978	185.058	87.133	-8.655
2300	14.473	75.973	64.484	26.424	184.728	82.683	-7.856
2400	14.506	76.589	64.976	27.873	184.392	78.257	-7.126
2500	14.536	77.182	65.452	29.325	184.056	73.843	-6.455
2600	14.562	77.753	65.914	30.780	183.714	69.441	-5.837
2700	14.586	78.303	66.363	32.237	183.371	65.051	-5.265
2800	14.607	78.834	66.799	33.697	183.028	60.679	-4.736
2900	14.626	79.346	67.223	35.159	182.678	56.312	-4.244
3000	14.644	79.843	67.635	36.622	182.326	51.960	-3.785
3100	14.660	80.323	68.037	38.087	181.973	47.616	-3.356
3200	14.674	80.789	68.428	39.554	181.616	43.296	-2.957
3300	14.687	81.240	68.810	41.022	181.254	38.970	-2.581
3400	14.700	81.679	69.182	42.491	180.890	34.670	-2.228
3500	14.711	82.105	69.545	43.962	180.522	30.373	-1.896
3600	14.721	82.520	69.899	45.434	180.152	26.089	-1.584
3700	14.731	82.923	70.246	46.906	179.781	21.815	-1.289
3800	14.739	83.316	70.585	48.380	179.399	17.548	-1.009
3900	14.748	83.699	70.916	49.854	179.016	13.291	-0.745
4000	14.755	84.073	71.241	51.329	178.631	9.048	-0.494
4100	14.762	84.437	71.558	52.805	178.241	4.813	-0.257
4200	14.769	84.793	71.869	54.282	177.846	0.592	-0.031
4300	14.775	85.141	72.173	55.759	177.445	-3.625	0.184
4400	14.781	85.480	72.472	57.237	177.042	-7.836	0.389
4500	14.786	85.813	72.765	58.715	176.633	-12.033	0.584
4600	14.791	86.138	73.052	60.194	176.219	-16.220	0.771
4700	14.796	86.456	73.334	61.673	175.802	-20.398	0.948
4800	14.800	86.767	73.610	63.153	175.377	-24.562	1.118
4900	14.804	87.073	73.882	64.633	174.949	-28.729	1.281
5000	14.808	87.372	74.149	66.114	174.516	-32.885	1.437
5100	14.812	87.665	74.411	67.595	174.074	-37.021	1.586
5200	14.815	87.953	74.669	69.076	173.629	-41.153	1.730
5300	14.819	88.235	74.922	70.558	173.179	-45.283	1.867
5400	14.822	88.512	75.171	72.040	172.723	-49.394	1.999
5500	14.825	88.784	75.416	73.522	172.258	-53.504	2.126
5600	14.827	89.051	75.657	75.005	171.791	-57.618	2.249
5700	14.830	89.313	75.895	76.488	171.315	-61.703	2.366
5800	14.833	89.571	76.128	77.971	170.833	-65.778	2.478
5900	14.835	89.825	76.358	79.454	170.345	-69.862	2.588
6000	14.837	90.075	76.585	80.938	169.849	-73.938	2.693

15 September 1962

CHW

TRIATOMIC CARBON (C₃) (IDEAL MOLECULAR GAS) gfw = 36.033

$$\Delta H^{\circ}_{f0} = 187.377 \text{ Kcal gfw}^{-1} \quad \Delta H^{\circ}_{f298.15} = 188.940 \text{ Kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S^{\circ}_{298.15} = 50.689 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^{\circ}_{298.15} - H^{\circ}_0 = 2.319 \text{ Kcal gfw}^{-1}$$

Vibrational levels and multiplicities

ω , cm ⁻¹	ω , cm ⁻¹
1300 (1)	2200 (1)
550 (2)	

Bond lengths and angles:

C-C distance = 1.281 Å

C-C-C Angle = 180 deg

Moment of inertia: = 65.448 x 10⁻⁴⁰ gcm²

$\sigma = 2$

Heat of Formation

Based on data of Drowart, et al¹

Heat Capacity and Entropy

Calculated on polyatomic gas computer program.

Reference

1. Drowart, J., et al, J. Chem. Phys. 31, 1131 (1959).

TABLE 126

CALCIUM

REFERENCE STATE

Ca

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ca from 0° to 1123°K,
 Liquid Ca from 1123° to 1765°K, Gaseous Ca from 1765° to 6000°K.

T, °K	C_p cal/°K gfw	S_T° cal/°K gfw	$-(F_T^\circ - H_{298}^\circ)/T$ cal/°K gfw	$H_T^\circ - H_{298}^\circ$ Kcal/gfw	ΔH_f° Kcal/gfw	ΔF_f° Kcal/gfw	Log K_p
0	0.000	0.000	INFINITE	-1.375			
298.15	6.280	9.950	9.950	0.000			
300	6.287	9.989	9.950	0.012			
400	6.647	11.847	10.201	0.658			
500	7.008	13.369	10.687	1.341			
600	7.368	14.678	11.245	2.060			
700	7.729	15.841	11.820	2.815			
737	7.862	16.243	12.332	3.103			
737	7.665	16.568	12.032	3.343			
800	8.083	17.214	12.415	3.839			
900	8.775	18.205	13.004	4.682			
1000	9.490	19.167	13.572	5.595			
1100	10.221	20.105	14.123	6.580			
1123	10.390	20.319	14.248	6.817			
1123	7.400	22.162	14.248	8.887			
1200	7.400	22.653	14.772	9.457			
1300	7.400	23.245	15.401	10.197			
1400	7.400	23.793	15.981	10.937			
1500	7.400	24.304	16.519	11.677			
1600	7.400	24.781	17.021	12.417			
1700	7.400	25.230	17.491	13.157			
1765	7.400	25.504	17.777	13.638			
1765	4.980	45.827	17.777	49.509			
1800	4.982	45.927	18.325	49.683			
1900	4.993	46.197	19.785	50.182			
2000	5.008	46.453	21.112	50.682			
2100	5.030	46.698	22.325	51.184			
2200	5.061	46.933	23.438	51.689			
2300	5.101	47.158	24.464	52.197			
2400	5.153	47.377	25.415	52.709			
2500	5.219	47.588	26.297	53.228			
2600	5.300	47.794	27.120	53.753			
2700	5.397	47.996	27.889	54.288			
2800	5.511	48.194	28.611	54.833			
2900	5.644	48.390	29.290	55.391			
3000	5.796	48.584	29.930	55.963			
3100	5.968	48.777	30.535	56.551			
3200	6.160	48.969	31.107	57.157			
3300	6.371	49.162	31.652	57.783			
3400	6.601	49.355	32.169	58.432			
3500	6.849	49.550	32.663	59.104			
3600	7.115	49.747	33.135	59.802			
3700	7.397	49.946	33.587	60.528			
3800	7.692	50.147	34.020	61.282			
3900	8.001	50.351	34.436	62.067			
4000	8.320	50.557	34.836	62.883			
4100	8.648	50.767	35.223	63.731			
4200	8.983	50.979	35.595	64.613			
4300	9.323	51.194	35.955	65.528			
4400	9.666	51.413	36.305	66.477			
4500	10.010	51.634	36.643	67.461			
4600	10.353	51.858	36.971	68.479			
4700	10.694	52.084	37.290	69.532			
4800	11.030	52.313	37.601	70.618			
4900	11.367	52.543	37.903	71.737			
5000	11.687	52.776	38.198	72.890			
5100	12.004	53.011	38.487	74.075			
5200	12.313	53.247	38.768	75.290			
5300	12.612	53.484	39.043	76.537			
5400	12.902	53.723	39.313	77.813			
5500	13.181	53.967	39.577	79.117			
5600	13.450	54.202	39.836	80.448			
5700	13.708	54.442	40.090	81.806			
5800	13.954	54.683	40.340	83.190			
5900	14.190	54.923	40.585	84.597			
6000	14.414	55.164	40.826	86.027			

May 1962

RCF

CALCIUM (Ca)

(REFERENCE STATE)

gfw = 40.08

0°K to 1123°K Crystal

1123°K to 1765°K Liquid

1765°K to 6000°K Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{s298.15}^{\circ} = 42.220 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 9.95 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_f = 737^{\circ}\text{K}$$

$$\Delta H_f = 0.240 \text{ kcal gfw}^{-1}$$

$$T_m = 1123^{\circ}\text{K}$$

$$\Delta H_m = 2.070 \text{ kcal gfw}^{-1}$$

$$T_b = 1765^{\circ}\text{K}$$

$$\Delta H_v = 45.871 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.375 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.205 + 3.605 \times 10^{-3} T \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 737^{\circ}\text{K}$$

$$C_p^{\circ} = 1.50 + 7.74 \times 10^{-3} T + 2.5 \times 10^{-5} T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$737^{\circ}\text{K} \leq T \leq 1123^{\circ}\text{K}$$

$$C_p^{\circ} = 7.400 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$1123^{\circ}\text{K} \leq T \leq 1765^{\circ}\text{K}$$

Structure

Low-temperature form has an f. c. c. structure, above 737°K, Ca has a b. c. c. structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data from Kelley and King.¹ High-temperature data based on Jauch,² and Eastman, Williams, and Young.³

Melting

Melting point from Kubaschewski et al.⁴

Vaporization

Average of several determinations.

Further details by Barriault et al.⁵

References

1. Kelley, K. K. and E. G. King, U. S. Bur. Mines, Bull. 592 (1961).
2. Jauch, R., Diplomarbeit, Techn. Hochschule, Stuttgart (1946).
3. Eastman, E.D., A. M. Williams, and T. F. Young, J. Am. Chem. Soc. **46**, 1178 (1924).
4. Kubaschewski, O. et al., Z. Elektrochem. **54**, 275 (1950).
5. Barriault, R. J. et al., ASD TR 61-260 (May 1962), Pt. 1.

CALCIUM (Ca)

(REFERENCE STATE)

GFW = 40.08

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p cal/ K gfw	S_T cal/ K gfw	$-(F_T - H_{298})/T$ Kcal/ gfw	$(H_T - H_{298})$ Kcal/ gfw	ΔH_f Kcal/ gfw	ΔF_f Kcal/ gfw	log K _p
298.15	±0.100	±0.100	±0.100	±0.000			
737	±0.200	±0.140	±0.120	±0.020			
737	±0.300	±0.230	±0.120	±0.080			
1123	±1.000	±0.370	±0.180	±0.220			
1123	±0.500	±0.460	±0.180	±0.320			
1765	±1.500	±0.690	±0.320	±0.640			
1765	±0.000	±0.002					
2000	±0.000	±0.002					
3000	±0.001	±0.002					
4000	±0.002	±0.002					
5000	±0.003	±0.003					
6000	±0.003	±0.003					

TABLE 127

CALCIUM

IDEAL MONATOMIC GAS

Ca

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ca from 0° to 1123°K,
Liquid Ca from 1123° to 1765°K, Gaseous Ca from 1765° to 6000°K.

T, °K	C_p	S_T	$\frac{C_p}{(T - T_{298})/T}$	H_f°	H_{298}	ΔH_f	ΔF_f	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	42.114	42.114	INFINITE	
298.15	4.968	36.993	36.993	0.000	42.220	34.157	-25.037	
300	4.968	37.024	36.993	0.009	42.217	34.107	-24.846	
400	4.968	38.453	37.188	0.506	42.068	31.426	-17.170	
500	4.968	39.562	37.556	1.003	41.887	28.786	-12.582	
600	4.968	40.468	37.968	1.500	41.660	26.186	-9.538	
700	4.968	41.273	38.381	1.996	41.401	23.627	-7.376	
737	4.968	41.489	38.531	2.180	41.297	22.690	-6.728	
737	4.968	41.489	38.531	2.180	41.057	22.690	-6.728	
800	4.968	41.897	38.780	2.493	40.874	21.127	-5.771	
900	4.968	42.482	39.160	2.990	40.528	18.679	-4.536	
1000	4.968	43.005	39.519	3.487	40.112	16.273	-3.556	
1100	4.968	43.479	39.857	3.984	39.624	13.913	-2.764	
1123	4.968	43.582	39.933	4.098	39.501	13.376	-2.603	
1123	4.968	43.582	39.933	4.098	37.431	13.376	-2.603	
1200	4.968	43.911	40.178	4.481	37.244	11.733	-2.137	
1300	4.968	44.309	40.480	4.977	37.000	9.616	-1.617	
1400	4.969	44.677	40.747	5.474	36.707	7.518	-1.174	
1500	4.970	45.020	41.039	5.971	36.354	5.438	-0.792	
1600	4.972	45.341	41.298	6.468	36.027	3.375	-0.461	
1700	4.976	45.647	41.545	6.966	36.029	1.327	-0.171	
1765	4.980	45.827	41.696	7.289	35.871	0.000	0.000	
1765	4.980	45.827	41.696	7.289				
1800	4.982	45.927	41.781	7.463				
1900	4.993	46.197	42.006	7.962				
2000	5.008	46.453	42.222	8.462				
2100	5.010	46.698	42.429	8.964				
2200	5.041	46.933	42.629	9.469				
2300	5.101	47.158	42.821	9.977				
2400	5.153	47.377	43.006	10.489				
2500	5.219	47.588	43.185	11.008				
2600	5.300	47.794	43.358	11.533				
2700	5.397	47.996	43.527	12.068				
2800	5.511	48.194	43.690	12.613				
2900	5.644	48.390	43.848	13.171				
3000	5.796	48.584	44.003	13.743				
3100	5.968	48.777	44.154	14.331				
3200	6.160	48.969	44.301	14.937				
3300	6.371	49.162	44.446	15.563				
3400	6.601	49.354	44.587	16.212				
3500	6.849	49.540	44.726	16.884				
3600	7.115	49.747	44.861	17.582				
3700	7.397	49.946	44.998	18.308				
3800	7.692	50.147	45.131	19.062				
3900	8.001	50.351	45.261	19.847				
4000	8.320	50.557	45.392	20.663				
4100	8.648	50.767	45.520	21.511				
4200	8.983	50.979	45.648	22.393				
4300	9.323	51.194	45.774	23.308				
4400	9.666	51.413	45.900	24.257				
4500	10.010	51.634	46.025	25.241				
4600	10.353	51.858	46.149	26.259				
4700	10.694	52.084	46.273	27.312				
4800	11.030	52.313	46.396	28.398				
4900	11.362	52.543	46.519	29.517				
5000	11.687	52.776	46.642	30.670				
5100	12.004	53.011	46.765	31.855				
5200	12.313	53.247	46.887	33.070				
5300	12.612	53.484	47.009	34.317				
5400	12.902	53.723	47.132	35.593				
5500	13.181	53.962	47.254	36.897				
5600	13.450	54.202	47.376	38.228				
5700	13.708	54.442	47.497	39.586				
5800	13.954	54.683	47.619	40.970				
5900	14.190	54.923	47.741	42.377				
6000	14.414	55.164	47.863	43.807				

May 1962

RCF

CALCIUM (Ca)

(IDEAL MONATOMIC GAS)

gfw - 40.08

$$\Delta H_{f0}^{\circ} = 42.114 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 42.220 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = 1s_0$$

$$S_{298.15}^{\circ} = 26.993 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Energy Levels from Moore.¹

Heat of Formation

Average of several determinations.

Heat Capacity and Entropy

Calculated on monatomic gas-computer program.

Further details by Barriault et al.²

References

1. Moore, C., Atomic Energy Levels, Vol. 1, Nat. Bur. Stds. (1949).
2. Barriault, R. J. et al., ASD TR 61-260 (May 1962), Pt. I.

CALCIUM, MONATOMIC (Ca)

(IDEAL GAS)

GFW = 40.08

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal °K gfw			kcal gfw			
	C_p°	S_T°	$-(F_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	ΔG_f°
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.250	± 0.300	± 0.220
737	± 0.000	± 0.002	± 0.002	± 0.000	± 0.250	± 0.340	± 0.110
737	± 0.000	± 0.002	± 0.002	± 0.000	± 0.250	± 0.340	± 0.110
1123	± 0.000	± 0.002	± 0.002	± 0.000	± 0.450	± 0.450	± 0.088
1123	± 0.000	± 0.002	± 0.002	± 0.000	± 0.550	± 0.450	± 0.088
1765	± 0.000	± 0.002	± 0.002	± 0.000	± 0.870	± 0.810	± 0.100
1765	± 0.000	± 0.002	± 0.002	± 0.000			
2000	± 0.000	± 0.002	± 0.002	± 0.000			
3000	± 0.001	± 0.002	± 0.002	± 0.001			
4000	± 0.002	± 0.002	± 0.002	± 0.002			
5000	± 0.003	± 0.003	± 0.003	± 0.003			
6000	± 0.003	± 0.003	± 0.003	± 0.005			

TABLE 128

CALCIUM OXIDE

CONDENSED PHASE

CaO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ca from 0° to 1123°K,
 Liquid Ca from 1123° to 1765°K, Gaseous Ca from 1765°K to 4000°K, Gaseous O_2 ,
 Solid CaO from 0° to 2860°K, Liquid CaO from 2860° to 6000°K.

T, °K	$\left(\frac{C_p}{T}\right)_P$	$\frac{cal}{°K \text{ gfw}}$ ΔT	$\left(\frac{C_p}{T} - \frac{H_{298}}{T}\right)$	$\left(\frac{H_T}{T} - \frac{H_{298}}{298}\right)$	$\frac{Kcal}{gfw}$ ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.668	-150.666	-150.666	INFINITE
298.15	10.230	9.561	9.561	0.000	-151.410	-143.988	105.541
300	10.254	9.624	9.561	0.019	-151.410	-143.942	104.857
400	11.120	12.708	9.976	1.093	-151.336	-141.463	77.288
500	11.574	15.243	10.784	2.230	-151.248	-139.005	60.756
600	11.878	17.383	11.710	3.404	-151.171	-136.564	49.741
700	12.101	19.231	12.655	4.603	-151.115	-134.134	41.877
737	12.177	19.856	13.001	5.052	-151.101	-133.237	39.508
737	12.172	19.856	13.001	5.052	-151.341	-133.237	39.508
800	12.283	20.859	13.581	5.822	-151.319	-131.690	35.974
900	12.442	22.315	14.472	7.059	-151.333	-129.236	31.381
1000	12.587	23.634	15.323	8.310	-151.408	-126.778	27.706
1100	12.722	24.840	16.134	9.576	-151.547	-124.309	24.697
1123	12.752	25.103	16.315	9.869	-151.588	-123.739	24.080
1123	12.752	25.103	16.315	9.869	-153.658	-123.739	24.080
1200	12.851	25.952	16.907	10.855	-153.569	-121.690	22.162
1300	12.975	26.986	17.643	12.146	-153.447	-119.039	20.011
1400	13.095	27.952	18.345	13.449	-153.315	-116.397	18.170
1500	13.214	28.859	19.016	14.765	-153.175	-113.765	16.575
1600	13.330	29.716	19.658	16.092	-153.026	-111.142	15.181
1700	13.445	30.527	20.274	17.431	-152.869	-108.529	13.952
1764.79	13.519	31.033	20.661	18.397	-152.762	-106.843	13.229
1764.79	13.519	31.033	20.661	18.397	-188.633	-106.843	13.229
1800	13.559	31.249	20.865	18.781	-188.489	-105.219	12.775
1900	13.672	32.015	21.434	20.143	-188.073	-100.605	11.572
2000	13.784	32.739	21.982	21.515	-187.651	-96.011	10.491
2100	13.896	33.415	22.510	22.899	-187.222	-91.439	9.516
2200	14.007	34.064	23.021	24.295	-186.787	-86.888	8.631
2300	14.118	34.689	23.514	25.701	-186.347	-82.359	7.826
2400	14.228	35.292	23.993	27.118	-185.902	-77.845	7.088
2500	14.338	35.875	24.456	28.546	-185.457	-73.354	6.412
2600	14.448	36.439	24.906	29.986	-185.009	-68.878	5.789
2700	14.558	36.987	25.344	31.436	-184.563	-64.422	5.214
2800	14.667	37.518	25.769	32.897	-184.117	-59.979	4.681
2860	14.733	37.870	26.019	33.779	-183.852	-57.327	4.380
2860	14.733	37.870	26.019	33.779	-183.852	-57.327	4.380
2860	14.733	37.870	26.019	33.779	-166.552	-57.327	4.380
2900	14.770	38.073	26.266	34.639	-166.407	-55.793	4.204
3000	14.870	38.612	26.869	35.289	-165.949	-51.989	3.787
3100	14.960	39.174	27.451	35.939	-165.222	-48.203	3.398
3200	15.050	39.657	28.013	36.589	-164.589	-44.442	3.035
3300	15.140	40.056	28.557	37.239	-164.117	-40.690	2.695
3400	15.230	40.477	29.083	37.889	-163.601	-36.961	2.376
3500	15.320	40.916	29.593	38.539	-163.110	-33.242	2.076
3600	15.410	41.361	30.088	39.189	-162.647	-29.537	1.793
3700	15.500	41.823	30.569	39.839	-162.214	-25.845	1.527
3800	15.590	42.303	31.035	40.489	-161.810	-22.164	1.275
3900	15.680	42.791	31.490	41.139	-161.430	-18.495	1.036
4000	15.770	43.287	31.932	41.789	-161.102	-14.835	0.810
4100	15.860	43.788	32.362	42.439	-160.798	-11.179	0.596
4200	15.950	44.304	32.782	43.089	-160.530	-7.534	0.392
4300	16.040	44.832	33.191	43.739	-160.296	-3.894	0.198
4400	16.130	45.372	33.590	44.389	-160.099	-0.254	0.013
4500	16.220	45.922	33.980	45.039	-159.939	3.375	-0.164
4600	16.310	46.485	34.361	45.689	-159.815	7.003	-0.333
4700	16.400	47.060	34.734	46.339	-159.728	10.629	-0.494
4800	16.490	47.647	35.098	46.989	-159.678	14.255	-0.649
4900	16.580	48.246	35.454	47.639	-159.663	17.877	-0.797
5000	16.670	48.851	35.803	48.289	-159.687	21.500	-0.940
5100	16.760	49.466	36.145	48.939	-159.747	25.128	-1.077
5200	16.850	50.092	36.479	49.589	-159.842	28.753	-1.208
5300	16.940	50.722	36.807	50.239	-159.975	32.379	-1.335
5400	17.030	51.353	37.129	50.889	-160.145	36.013	-1.457
5500	17.120	51.983	37.445	51.539	-160.352	39.649	-1.575
5600	17.210	52.613	37.754	52.189	-160.596	43.287	-1.689
5700	17.300	53.243	38.058	52.839	-160.880	46.933	-1.799
5800	17.390	53.873	38.356	53.489	-161.200	50.587	-1.906
5900	17.480	54.503	38.650	54.139	-161.574	54.243	-2.009
6000	17.570	55.133	38.938	54.789	-161.986	57.908	-2.109

15 December 1962

RCE

$$\Delta H_{f298.15}^{\circ} = -151.410 \text{ kcal gfw}^{-1} \quad S_{298.15}^{\circ} = 9.561 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2860^{\circ}\text{K}$$

$$\Delta H_m = 17.200 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.668 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.67 + 1.08 \times 10^{-3}T - 1.56 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 2860^{\circ}\text{K}$$

$$C_p^{\circ} = 16.5 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2860^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

An fcc (NaCl) type.

Heat of Formation

Obtained from combustion calorimetry by Huber and Holley.¹

Heat Capacity and Entropy

Low-temperature data of Nernst and Schwes² and Parks and Kelley³ analyzed by Barriault et al.⁴ High-temperature data of Kelley⁵ extrapolated to melting point. Liquid heat capacity estimated.

Melting and Vaporization

Heat of fusion estimated.

References

1. Huber, E. J. and C. E. Holley, J. Phys. Chem. **60**, 498 (1956).
2. Nernst, W. and F. Schwes, Sitzb. Konig. Preuss. Akad. Wiss. **1**, 355 (1914).
3. Parks, G. S. and K. K. Kelley, J. Phys. Chem. **30**, 47 (1926).
4. Barriault, R. J. et al, ASD TR 61-260 (May 1962), Pt. 1.
5. Kelley, K. K., U.S. Bur. Mines, Bull. 584 (1960).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔH_v°	$\log K_p$
298.15	± 0.200	± 0.150	± 0.150	± 0.000	± 0.500	± 0.570	± 0.420
1000	± 0.430	± 0.290	± 0.210	± 0.080	± 0.760	± 0.870	± 0.190
2000	± 0.930	± 0.460	± 0.300	± 0.330	± 1.700	± 1.540	± 0.170
2860	± 1.740	± 0.610	± 0.370	± 0.680	± 2.050	± 1.860	± 0.140
2860	± 1.000	± 1.100	± 0.370	± 2.080	± 3.450	± 1.860	± 0.140
4000	± 2.000	± 1.600	± 0.650	± 3.790	± 5.160	± 3.320	± 0.180

TABLE 129

CALCIUM OXIDE

IDEAL MOLECULAR GAS

CaO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ca from 0° to 1123°K,
Liquid Ca from 1123° to 1765°K, Gaseous Ca from 1765° to 6000°K, Gaseous O₂, Gaseous CaO.

T, °K	ϵ_p°	ϵ_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.117	1.095	1.095	INFINITE
298.15	7.553	54.217	54.217	0.000	0.800	-5.092	3.733
300	7.561	54.263	54.217	0.014	0.795	-5.129	3.736
400	7.957	56.495	54.518	0.791	0.572	-7.070	3.863
500	8.233	58.301	55.100	1.601	0.333	-8.953	3.913
600	8.427	59.820	55.763	2.434	0.069	-10.786	3.928
700	8.564	61.130	56.439	3.284	-0.224	-12.573	3.925
737	8.604	61.572	56.685	3.602	-0.341	-13.222	3.921
737	8.604	61.572	56.685	3.602	-0.581	-13.222	3.921
800	8.663	62.281	57.099	4.146	-0.786	-14.295	3.905
900	8.737	63.305	57.732	5.016	-1.165	-15.960	3.875
1000	8.795	64.224	58.337	5.892	-1.617	-17.582	3.842
1100	8.841	65.069	58.911	6.774	-2.139	-19.153	3.805
1123	8.850	65.253	59.039	6.978	-2.269	-19.508	3.796
1123	8.850	65.253	59.039	6.978	-4.339	-19.508	3.796
1200	8.879	65.840	59.457	7.660	-4.554	-20.540	3.741
1300	8.911	66.552	59.976	8.550	-4.833	-21.862	3.675
1400	8.938	67.114	60.469	9.442	-5.115	-23.161	3.615
1500	8.963	67.531	60.940	10.337	-5.393	-24.441	3.561
1600	8.985	68.411	61.389	11.235	-5.673	-25.702	3.511
1700	9.005	68.956	61.818	12.134	-5.956	-26.944	3.464
1764.74	9.017	69.194	62.087	12.720	-6.139	-27.750	3.436
1764.74	9.017	69.294	62.087	12.720	-42.010	-27.750	3.436
1800	9.023	69.471	62.229	13.036	-42.024	-27.465	3.334
1900	9.043	69.960	62.623	13.939	-42.067	-26.654	3.066
2000	9.058	70.424	63.002	14.844	-42.112	-25.842	2.824
2100	9.075	70.866	63.366	15.750	-42.161	-25.027	2.604
2200	9.091	71.289	63.717	16.659	-42.213	-24.211	2.405
2300	9.108	71.694	64.055	17.569	-42.269	-23.393	2.223
2400	9.125	72.082	64.382	18.480	-42.331	-22.570	2.055
2500	9.142	72.455	64.697	19.394	-42.399	-21.746	1.901
2600	9.161	72.814	65.003	20.309	-42.476	-20.919	1.758
2700	9.180	73.160	65.299	21.226	-42.563	-20.091	1.626
2800	9.200	73.494	65.586	22.145	-42.660	-19.256	1.503
2900	9.221	73.818	65.865	23.066	-42.771	-18.420	1.388
3000	9.244	74.132	66.135	23.989	-42.887	-17.577	1.280
3100	9.268	74.436	66.399	24.915	-43.003	-16.732	1.180
3200	9.293	74.731	66.655	25.843	-43.119	-15.886	1.085
3300	9.320	75.017	66.904	26.773	-43.234	-15.027	0.995
3400	9.349	75.297	67.147	27.707	-43.354	-14.169	0.911
3500	9.378	75.568	67.385	28.643	-43.479	-13.303	0.831
3600	9.410	75.834	67.616	29.583	-44.044	-12.428	0.754
3700	9.443	76.092	67.842	30.525	-44.318	-11.547	0.682
3800	9.477	76.345	68.063	31.471	-44.619	-10.659	0.613
3900	9.513	76.593	68.280	32.421	-44.948	-9.767	0.547
4000	9.551	76.835	68.491	33.374	-45.307	-8.862	0.484
4100	9.590	77.072	68.698	34.331	-45.696	-7.945	0.424
4200	9.630	77.304	68.901	35.292	-46.117	-7.025	0.366
4300	9.672	77.532	69.100	36.257	-46.569	-6.093	0.310
4400	9.714	77.756	69.295	37.227	-47.052	-5.144	0.256
4500	9.758	77.975	69.486	38.200	-47.568	-4.191	0.204
4600	9.803	78.191	69.674	39.179	-48.115	-3.225	0.153
4700	9.849	78.404	69.859	40.161	-48.697	-2.250	0.105
4800	9.896	78.613	70.040	41.149	-49.308	-1.257	0.057
4900	9.944	78.818	70.218	42.141	-49.952	-0.256	0.011
5000	9.993	79.021	70.393	43.138	-50.628	0.760	-0.033
5100	10.042	79.220	70.566	44.140	-51.336	1.789	-0.077
5200	10.092	79.417	70.735	45.147	-52.074	2.833	-0.119
5300	10.142	79.611	70.907	46.159	-52.845	3.887	-0.160
5400	10.193	79.803	71.067	47.176	-53.648	4.958	-0.201
5500	10.244	79.997	71.229	48.198	-54.483	6.044	-0.240
5600	10.296	80.178	71.388	49.221	-55.350	7.148	-0.279
5700	10.348	80.363	71.546	50.258	-56.252	8.261	-0.317
5800	10.400	80.545	71.701	51.296	-57.190	9.398	-0.354
5900	10.453	80.725	71.854	52.339	-58.164	10.547	-0.391
6000	10.505	80.903	72.000	53.381	-59.179	11.714	-0.427

15 December 1962

RCF

$$\Delta H_{f0}^{\circ} = 1.095 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0.800 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^3\Sigma$$

$$S_{298.15}^{\circ} = 54.217 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.117 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$X^3\Sigma$	-	0	850.0	5.0	-	0.53	0.004	-	0.7
$X'^1\Sigma$	-	15000	732.11	4.81	-	0.44447	0.00335	-	0.656
${}^3\Sigma$	-	20000	725.0	4.0	-	0.45	0.003	-	0.7

Heat of Formation

Average heat of dissociation of 100 kcal gfw⁻¹ adopted. Based on works of Brewer,^{1,2} Gaydon,³ and Ackermann et al.⁴

Heat Capacity and Entropy

Calculated on diatomic-gas program using above spectroscopic constants.

References

1. Brewer, L., Chem. Revs. 52, 1 (1953).
2. Brewer, L., U. S. AEC Rept., UCRL-8356 (1958).
3. Gaydon, A. G., Dissociation Energies, 2nd ed., Chapman and Hall, London (1953).
4. Ackermann, R. J., R. J. Thorn, and G. H. Winslow, Planet. Space Sci. 3, 12 (1961).

TABLE 130

CERIUM

REFERENCE STATE

Ce

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p . Solid Ce from 0° to 1077°K,
Liquid from 1077° to 4271°K, Gas from 4271° to 6000°K.

T, °K	C_p	S_T	$-(H_T - H_{298})/T$	$(H_T - H_{298})$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-2.133			
298.15	6.440	17.640	17.640	0.000			
300	6.446	17.680	17.640	0.012			
400	6.759	19.576	17.897	0.677			
500	7.096	21.120	18.391	1.364			
600	7.456	22.446	18.959	2.092			
700	7.840	23.623	19.543	2.856			
800	8.248	24.647	20.121	3.661			
900	8.680	25.623	20.685	4.507			
1000	9.135	26.631	21.233	5.397			
1003	9.149	26.658	21.250	5.425			
1003	9.047	27.356	21.250	6.125			
1077	9.047	28.000	21.692	6.794			
1077	9.345	29.149	21.692	8.032			
1100	9.345	29.347	21.850	8.247			
1200	9.345	30.160	22.509	9.182			
1300	9.345	30.908	23.126	10.116			
1400	9.345	31.601	23.707	11.051			
1500	9.345	32.246	24.255	11.985			
1600	9.345	32.849	24.774	12.920			
1700	9.345	33.411	25.266	13.854			
1800	9.345	33.949	25.733	14.789			
1900	9.345	34.465	26.179	15.723			
2000	9.345	34.954	26.605	16.658			
2100	9.345	35.430	27.013	17.592			
2200	9.345	35.891	27.403	18.527			
2300	9.345	36.340	27.779	19.461			
2400	9.345	36.678	28.139	20.396			
2500	9.345	37.011	28.487	21.330			
2600	9.345	37.386	28.822	22.265			
2700	9.345	37.736	29.146	23.199			
2800	9.345	38.078	29.459	24.134			
2900	9.345	38.406	29.762	25.068			
3000	9.345	38.723	30.055	26.003			
3100	9.345	39.029	30.340	26.937			
3200	9.345	39.326	30.616	27.872			
3300	9.345	39.614	30.884	28.806			
3400	9.345	39.893	31.145	29.741			
3500	9.345	40.165	31.399	30.675			
3600	9.345	40.427	31.646	31.610			
3700	9.345	40.683	31.887	32.544			
3800	9.345	40.932	32.121	33.479			
3900	9.345	41.175	32.351	34.413			
4000	9.345	41.411	32.574	35.348			
4100	9.345	41.642	32.793	36.282			
4200	9.345	41.862	33.006	37.217			
4270.71	9.345	42.087	33.214	37.880			
4270.71	42.087	42.306	33.416	124.889			
4300	42.216	62.452	33.352	125.127			
4400	62.264	67.641	34.216	125.751			
4500	62.312	67.826	34.655	126.780			
4600	62.360	63.011	35.269	7.614			
4700	62.407	63.141	35.860	128.452			
4800	62.453	63.265	36.433	129.295			
4900	62.498	63.383	36.984	130.142			
5000	62.542	63.493	37.516	130.994			
5100	62.584	63.595	38.032	131.851			
5200	62.624	63.692	38.531	132.711			
5300	62.663	63.787	39.014	133.576			
5400	62.699	63.879	39.482	134.444			
5500	62.734	63.969	39.936	135.315			
5600	62.766	64.057	40.377	136.190			
5700	62.795	64.141	40.805	137.068			
5800	62.822	64.221	41.221	137.949			
5900	62.846	64.296	41.625	138.833			
6000	62.868	64.365	42.019	139.718			

15 December 1962

RCF

CERIUM (Ce)

(REFERENCE STATE)

gfw = 140.13

0°K to 1077°K
1077°K to 4271°K
4271°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 95.000 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 17.640 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_l = 1003^{\circ}\text{K}$$

$$\Delta H_l = 0.700 \text{ kcal gfw}^{-1}$$

$$T_m = 1077^{\circ}\text{K}$$

$$\Delta H_m = 1.238 \text{ kcal gfw}^{-1}$$

$$T_b = 4271^{\circ}\text{K}$$

$$\Delta H_v = 87.009 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.509 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.649 + 2.300 \times 10^{-3}T + 11.862 \times 10^{-7}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 1003^{\circ}\text{K}$$

$$C_p^{\circ} = 9.047 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1003^{\circ}\text{K} \leq T \leq 1077^{\circ}\text{K}$$

$$C_p^{\circ} = 9.345 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1077^{\circ}\text{K} \leq T \leq 4271^{\circ}\text{K}$$

Structure

γ -Ce is f. c. c. from 260° to 1003°K. δ -Ce is b. c. c. from 1003° to 1077°K.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data estimated. See volume 1, this study (section IVA5) for details. High-temperature data by Spedding *et al.*¹

Melting and Vaporization

Heats of transition and fusion from Spedding *et al.*¹ Heat of vaporization value recommended by Spedding and Daane.²

References

1. Spedding, F. H. *et al.*, J. Phys. Chem. **64**, 289 (1960)
2. Spedding, F. H. and A. H. Daane, Met. Rev. **5**, 297 (1960).

CERIUM (Ce)

(REFERENCE STATE)

GFW = 140.13

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_l°	ΔH_v°	log K _p
298.15	± 0.050	± 0.800	± 0.800	± 0.000			
1003	± 0.050	± 0.830	± 0.810	± 0.020			
1003	± 0.050	± 0.838	± 0.810	± 0.028			
1077	± 0.050	± 0.840	± 0.810	± 0.030			
1077	± 0.050	± 0.844	± 0.810	± 0.034			
2000	± 0.100	± 0.900	± 0.840	± 0.110			
3000	± 1.000	± 1.120	± 0.900	± 0.660			
4000	± 2.900	± 1.680	± 1.030	± 2.610			
4270.73	± 3.400	± 1.890	± 1.080	± 3.460			
4270.73	± 0.300	± 0.770	± 0.660	± 0.490			
5000	± 0.400	± 0.830	± 0.680	± 0.750			
6000	± 0.500	± 0.910	± 0.710	± 1.200			

TABLE 131

CERIUM

IDEAL MONATOMIC GAS

Ce

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ce from 0° to 1077°K,
Liquid Ce from 1077° to 4271°K, Gaseous Ce from 4271° to 6000°K.

T, °K	ΔH_f° cal/gw	ΔF_f° cal/gw	ΔH_f° Kcal/gw	ΔF_f° Kcal/gw	$\log K_p$		
0	0.000	0.000	INFINITE	-1.509	95.624	95.624	INFINITE
298.15	5.438	43.591	43.591	0.000	95.000	87.263	-63.962
300	5.447	43.625	43.591	0.010	94.998	87.215	-63.533
400	5.894	45.255	43.810	0.577	94.905	84.635	-46.240
500	6.219	46.608	44.238	1.185	94.821	82.076	-35.874
600	6.455	47.763	44.732	1.819	94.727	79.536	-28.970
700	6.666	48.774	45.239	2.475	94.619	77.013	-24.043
800	6.874	49.678	45.738	3.152	94.491	74.506	-20.353
900	7.073	50.469	46.222	3.849	94.342	72.017	-17.487
1000	7.248	51.254	46.688	4.566	94.169	69.545	-15.198
1003	7.253	51.275	46.702	4.588	94.163	69.472	-15.137
1003	7.253	51.275	46.702	4.588	93.463	69.472	-15.137
1077	7.361	51.796	47.034	5.128	93.334	67.707	-13.739
1077	7.361	51.796	47.034	5.128	92.096	67.707	-13.739
1100	7.391	51.952	47.135	5.298	92.051	67.186	-13.348
1200	7.497	51.559	47.564	6.043	91.861	64.934	-11.826
1300	7.571	53.702	47.975	6.796	91.710	62.696	-10.540
1400	7.618	53.766	48.368	7.556	91.505	60.475	-9.440
1500	7.645	54.292	48.747	8.319	91.334	58.264	-8.489
1600	7.657	54.786	49.108	9.084	91.164	56.066	-7.658
1700	7.660	55.250	49.456	9.850	90.996	53.877	-6.926
1800	7.658	55.688	49.790	10.616	90.827	51.697	-6.277
1900	7.653	56.102	50.112	11.382	90.659	49.527	-5.697
2000	7.648	56.494	50.421	12.147	90.489	47.368	-5.176
2100	7.644	56.867	50.719	12.911	90.319	45.217	-4.706
2200	7.641	57.224	51.007	13.676	90.149	43.071	-4.279
2300	7.640	57.564	51.284	14.440	89.979	40.938	-3.890
2400	7.642	57.888	51.553	15.204	89.808	38.806	-3.534
2500	7.647	58.200	51.813	15.968	89.638	36.685	-3.207
2600	7.655	58.500	52.064	16.733	89.468	34.571	-2.906
2700	7.666	58.784	52.308	17.497	89.300	32.463	-2.628
2800	7.680	59.061	52.544	18.267	89.133	30.362	-2.370
2900	7.698	59.334	52.774	19.036	88.968	28.265	-2.130
3000	7.718	59.599	52.997	19.806	88.803	26.174	-1.907
3100	7.742	59.853	53.214	20.579	88.637	24.091	-1.698
3200	7.769	60.094	53.425	21.355	88.488	22.011	-1.503
3300	7.799	60.338	53.631	22.133	88.347	19.935	-1.320
3400	7.832	60.572	53.832	22.915	88.174	17.864	-1.148
3500	7.867	60.794	54.028	23.700	88.025	15.798	-0.986
3600	7.905	61.021	54.219	24.488	87.878	13.737	-0.834
3700	7.945	61.249	54.406	25.281	87.737	11.680	-0.690
3800	7.987	61.461	54.588	26.077	87.598	9.629	-0.554
3900	8.030	61.659	54.767	26.878	87.465	7.578	-0.425
4000	8.075	61.843	54.944	27.683	87.335	5.528	-0.302
4100	8.122	62.063	55.113	28.493	87.211	3.488	-0.186
4200	8.169	62.259	55.281	29.308	87.091	1.445	-0.075
4270.71	8.202	62.396	55.398	29.889	87.000	0.000	0.000
4270.71	8.202	62.396	55.398	29.889			
4300	8.216	62.652	55.446	30.127			
4400	8.264	62.851	55.607	30.951			
4500	8.312	62.828	55.765	31.780			
4600	8.360	63.011	55.921	32.614			
4700	8.407	63.191	56.074	33.452			
4800	8.453	63.364	56.224	34.295			
4900	8.498	63.543	56.371	35.142			
5000	8.542	63.715	56.517	35.994			
5100	8.584	63.885	56.659	36.851			
5200	8.624	64.052	56.800	37.711			
5300	8.663	64.217	56.938	38.576			
5400	8.699	64.379	57.072	39.444			
5500	8.734	64.539	57.202	40.315			
5600	8.766	64.697	57.341	41.190			
5700	8.795	64.852	57.477	42.068			
5800	8.822	65.005	57.600	42.949			
5900	8.846	65.156	57.727	43.833			
6000	8.868	65.305	57.847	44.718			

15 December 1962

RCF

15 December 1962

RCF

CERIUM (Ce)

(IDEAL MONATOMIC GAS)

gfw = 140.13

$$\Delta H_{f0}^{\circ} = 95.624 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 95.000 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = 2D_{1\frac{1}{2}}$$

$$S_{298.15}^{\circ} = 43.591 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.509 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Electronic levels for Ce were assumed to be same as those for La as given by Moore.¹

Heat of Formation

Based on several values. Value by Spedding and Daane² adopted.

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

References

1. Moore, C., Atomic Energy Levels, Vol. 3, Nat. Bur. Stds. (U. S.) (1958).
2. Spedding, F. H. and A. H. Daane, Met. Rev. 5, 297 (1960).

CERIUM MONATOMIC (Ce)

(IDEAL GAS)

GFW = 140.13

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f	ΔF _f	
298.15	± 0.200	± 0.500	± 0.500	± 0.000	± 2.500	± 2.890	± 2.120
1003	± 0.150	± 0.590	± 0.540	± 0.050	± 2.570	± 3.850	± 0.840
1003	± 0.150	± 0.590	± 0.540	± 0.050	± 2.580	± 3.850	± 0.840
1077	± 0.150	± 0.600	± 0.540	± 0.060	± 2.590	± 3.950	± 0.800
1077	± 0.150	± 0.600	± 0.540	± 0.060	± 2.600	± 3.950	± 0.800
2000	± 0.100	± 0.670	± 0.590	± 0.170	± 2.780	± 5.360	± 0.590
3000	± 0.100	± 0.710	± 0.620	± 0.270	± 3.430	± 7.060	± 0.510
4000	± 0.200	± 0.760	± 0.650	± 0.420	± 5.530	± 9.220	± 0.500
4270.73	± 0.300	± 0.770	± 0.660	± 0.490	± 6.450	± 9.930	± 0.510
4270.73	± 0.300	± 0.770	± 0.660	± 0.490			
5000	± 0.400	± 0.830	± 0.680	± 0.750			
6000	± 0.500	± 0.910	± 0.710	± 1.200			

TABLE 132

CERIUM OXIDE

IDEAL MOLECULAR GAS

CeO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ce from 0° to 1077°K, Liquid Ce from 1077° to 4271°K, Gaseous Ce from 4271° to 6000°K, Gaseous O₂, Gaseous CeO.

T, °K	C_p°	C_p°	$(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.114	-30.044	-30.044	INFINITE
298.15	7.521	57.219	57.219	0.000	-31.100	-35.595	26.090
300	7.529	57.266	57.200	0.014	-31.105	-35.617	25.946
400	7.915	59.487	57.520	0.787	-31.347	-37.092	20.265
500	8.196	61.285	58.099	1.593	-31.598	-38.501	16.828
600	8.391	62.798	58.759	2.423	-31.874	-39.855	14.516
700	8.528	64.163	59.432	3.270	-32.180	-41.162	12.851
800	8.626	65.248	60.188	4.128	-32.526	-42.421	11.588
900	8.699	66.269	60.719	4.994	-32.913	-43.636	10.596
1000	8.755	67.188	61.321	5.867	-33.344	-44.805	9.792
1003	8.756	67.213	61.338	5.893	-33.358	-44.838	9.769
1003	8.756	67.213	61.338	5.893	-34.058	-44.838	9.769
1077	8.789	67.837	61.763	6.543	-34.387	-45.621	9.257
1077	8.789	67.837	61.763	6.543	-35.625	-45.621	9.257
1100	8.799	68.025	61.893	6.745	-35.735	-45.834	9.106
1200	8.834	68.792	62.436	7.626	-36.213	-46.731	8.510
1300	8.864	69.500	62.953	8.511	-36.721	-47.590	8.000
1400	8.889	70.158	63.444	9.399	-37.170	-48.410	7.557
1500	8.911	70.772	63.913	10.289	-37.649	-49.197	7.168
1600	8.933	71.348	64.360	11.181	-38.130	-49.950	6.823
1700	8.954	71.890	64.787	12.076	-38.611	-50.674	6.514
1800	8.975	72.402	65.196	12.977	-39.094	-51.371	6.237
1900	8.999	72.888	65.588	13.871	-39.576	-52.039	5.986
2000	9.025	73.351	65.965	14.772	-40.060	-52.682	5.757
2100	9.054	73.792	66.327	15.676	-40.543	-53.300	5.547
2200	9.087	74.214	66.676	16.583	-41.027	-53.897	5.354
2300	9.125	74.618	67.013	17.493	-41.509	-54.471	5.176
2400	9.167	75.008	67.338	18.408	-41.990	-55.027	5.011
2500	9.215	75.383	67.652	19.327	-42.469	-55.559	4.857
2600	9.268	75.745	67.957	20.251	-42.946	-56.074	4.713
2700	9.325	76.096	68.252	21.181	-43.419	-56.570	4.579
2800	9.387	76.437	68.538	22.116	-43.889	-57.048	4.453
2900	9.454	76.767	68.816	23.058	-44.356	-57.509	4.334
3000	9.525	77.089	69.087	24.007	-44.817	-57.958	4.222
3100	9.600	77.403	69.350	24.963	-45.274	-58.385	4.116
3200	9.678	77.709	69.607	25.927	-45.727	-58.804	4.016
3300	9.759	78.008	69.857	26.899	-46.177	-59.206	3.921
3400	9.842	78.301	70.101	27.879	-46.616	-59.594	3.830
3500	9.926	78.588	70.340	28.868	-47.043	-59.970	3.745
3600	10.012	78.869	70.573	29.864	-47.471	-60.334	3.663
3700	10.098	79.144	70.801	30.870	-47.889	-60.685	3.584
3800	10.184	79.415	71.024	31.884	-48.303	-61.023	3.509
3900	10.270	79.681	71.243	32.907	-48.708	-61.354	3.438
4000	10.355	79.942	71.458	33.938	-49.108	-61.678	3.370
4100	10.439	80.199	71.668	34.978	-49.500	-61.985	3.304
4200	10.521	80.452	71.874	36.026	-49.887	-62.285	3.241
4270.73	10.578	80.629	72.018	36.775	-50.157	-62.494	3.198
4270.73	10.578	80.629	72.018	36.775	-137.166	-62.494	3.198
4300	10.601	80.701	72.077	37.082	-137.243	-61.987	3.150
4400	10.679	80.945	72.276	38.146	-137.507	-60.232	2.992
4500	10.754	81.187	72.472	39.217	-137.770	-58.474	2.840
4600	10.827	81.424	72.664	40.292	-138.033	-56.708	2.694
4700	10.896	81.658	72.853	41.382	-138.296	-54.943	2.555
4800	10.963	81.888	73.039	42.475	-138.559	-53.158	2.420
4900	11.026	82.115	73.223	43.575	-138.823	-51.384	2.292
5000	11.087	82.339	73.403	44.680	-139.090	-49.600	2.168
5100	11.144	82.560	73.581	45.792	-139.360	-47.808	2.049
5200	11.197	82.777	73.756	46.909	-139.633	-46.008	1.934
5300	11.247	82.991	73.929	48.031	-139.913	-44.210	1.823
5400	11.295	83.202	74.099	49.158	-140.198	-42.402	1.716
5500	11.338	83.410	74.267	50.289	-140.490	-40.590	1.613
5600	11.379	83.616	74.432	51.425	-140.792	-38.769	1.513
5700	11.417	83.818	74.596	52.565	-141.107	-36.948	1.417
5800	11.451	84.017	74.757	53.708	-141.437	-35.116	1.323
5900	11.483	84.214	74.916	54.854	-141.785	-33.283	1.233
6000	11.512	84.407	75.074	56.004	-142.153	-31.436	1.145

15 December 1962

RCF

CERIUM MONOXIDE (CeO) (IDEAL MOLECULAR GAS) gfw = 156.13

$$\Delta H_{f0}^{\circ} = -30\,044 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -31.1 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 2

$$S_{298.15}^{\circ} = 57\,219 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2\,114 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	2	0	865	2.99	—	0.359	—	—	0.25
A	2	12764.3	785.3	2.13	—	0.326	—	—	0.22
B	2	13817.2	788.3	1.76	—	0.327	—	—	0.23
X'	2	13720.	840.2	2.58	—	0.349	—	—	0.23
D	2	34276.	791.7	1.72	—	0.329	—	—	0.23
E	2	34584	807.9	2.04	—	0.335	—	—	0.23

Heat of Formation

Based on data of Walsh, Dever, and White.¹ See volume 1, this study (section IVB5.4) for details.

Heat Capacity and Entropy

Calculated using above spectroscopic constants, which are from Herzberg² or have been estimated.

References

1. Walsh, P. N., D. F. Dever, and D. White, J. Phys. Chem. 65, 1410 (1961).
2. Herzberg, G., Spectra of Diatomic Molecules I., 2nd ed, Van Nostrand, N. Y. (1950)

TABLE 133

CHROMIUM

REFERENCE STATE

Cr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Cr from 0° to 2148°K,
Liquid Cr from 2148 to 2967°K, Gaseous Cr from 2967 to 6000°K.

T, °K	C_p	S_f	$(F_f - H_{298})/T$	$(H_f - H_{298})$	ΔH_f	ΔF_f	$\log K_p$
0	0.000	0.000	INFINITE	-0.970			
298.15	5.577	5.680	5.680	0.000			
300	5.579	5.714	5.681	0.010			
311.65	5.597	5.934	5.687	0.077			
311.65	5.597	5.938	5.687	0.078			
400	5.800	7.400	5.913	0.595			
500	6.090	8.794	6.354	1.220			
600	6.415	9.978	6.861	1.870			
700	6.755	10.995	7.380	2.530			
800	7.103	11.902	7.890	3.210			
900	7.455	12.726	8.382	3.910			
1000	7.810	13.495	8.855	4.640			
1100	8.167	14.229	9.310	5.410			
1200	8.525	14.942	9.750	6.230			
1300	8.884	15.638	10.177	7.100			
1400	9.243	16.312	10.591	8.010			
1500	9.603	16.961	10.994	8.950			
1600	9.964	17.587	11.387	9.920			
1648	10.137	17.882	11.571	10.400			
1648	10.137	18.368	11.571	11.200			
1700	10.324	18.684	11.784	11.730			
1800	10.685	19.284	12.184	12.780			
1900	11.046	19.879	12.573	13.880			
2000	11.408	20.463	12.953	15.020			
2088	11.726	20.975	13.281	16.065			
2088	11.726	21.142	13.281	16.415			
2100	11.769	21.212	13.327	16.560			
2148	11.942	21.486	13.517	17.117			
2148	9.400	23.786	13.517	2.057			
2200	9.400	24.221	13.763	22.545			
2300	9.400	24.472	14.218	23.485			
2400	9.400	24.829	14.652	24.425			
2500	9.400	25.213	15.067	25.465			
2600	9.400	25.581	15.464	26.305			
2700	9.400	25.936	15.845	27.245			
2800	9.400	26.278	16.212	28.185			
2900	9.400	26.608	16.565	29.125			
2967	9.400	26.822	16.794	29.755			
2967	7.317	53.861	16.794	109.274			
3000	7.352	53.943	17.204	110.216			
3100	7.481	54.186	18.393	110.958			
3200	7.599	54.425	19.515	111.712			
3300	7.713	54.661	20.577	112.478			
3400	7.825	54.893	21.583	113.255			
3500	7.935	55.121	22.537	114.043			
3600	8.045	55.346	23.445	114.842			
3700	8.157	55.568	24.311	115.652			
3800	8.270	55.787	25.136	116.473			
3900	8.386	56.004	25.926	117.306			
4000	8.506	56.217	26.679	118.151			
4100	8.631	56.429	27.402	119.008			
4200	8.761	56.638	28.096	119.877			
4300	8.896	56.846	28.762	120.760			
4400	9.036	57.052	29.403	121.657			
4500	9.181	57.257	30.020	122.567			
4600	9.335	57.460	30.614	123.493			
4700	9.492	57.663	31.187	124.435			
4800	9.654	57.864	31.741	125.392			
4900	9.821	58.065	32.276	126.366			
5000	9.992	58.265	32.794	127.356			
5100	10.167	58.465	33.296	128.364			
5200	10.344	58.664	33.781	129.390			
5300	10.524	58.863	34.253	130.433			
5400	10.705	59.061	34.710	131.495			
5500	10.887	59.259	35.155	132.574			
5600	11.069	59.457	35.587	133.672			
5700	11.250	59.655	36.008	134.788			
5800	11.429	59.852	36.417	135.922			
5900	11.605	60.049	36.816	137.074			
6000	11.779	60.245	37.204	138.243			

May 1962

CIW

CHROMIUM (Cr)

(REFERENCE STATE)
0°K to 2148°K Crystal

gfw = 52.01

2148°K to 2967°K Liquid

2967°K to 6000°K Ideal Monatomic Gas

$\Delta H_{f0}^{\circ} = 0$	$\Delta H_{f298.15}^{\circ} = 0$
$\Delta H_{298.15}^{\circ} = 94.820 \text{ kcal gfw}^{-1}$	$S_{298.15}^{\circ} = 5.68 \text{ cal degK}^{-1} \text{ gfw}^{-1}$
$T_f = 311.65^{\circ}\text{K}$	$\Delta H_f = 0.0014 \text{ kcal gfw}^{-1}$
$T_t = 1648^{\circ}\text{K}$	$\Delta H_t = 0.800 \text{ kcal gfw}^{-1}$
$T_{tr} = 2088^{\circ}\text{K}$	$\Delta H_{tr} = 0.350 \text{ kcal gfw}^{-1}$
$T_m = 2148^{\circ}\text{K}$	$\Delta H_m = 4.92 \text{ kcal gfw}^{-1}$
$T_b = 2967^{\circ}\text{K}$	$\Delta H_v = 80.220 \text{ kcal gfw}^{-1}$
$H_{298.15}^{\circ} - H_0^{\circ} = 0.970 \text{ kcal gfw}^{-1}$	

Structure

The stable form at 298.15°K is b. c. c., an antiferromagnetic transition occurs at 311.65°K. A second occurs at 1648°K. At 2088°K, the b. c. c. transforms into f. c. c. structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data from earlier works of Hultgren and identical with their final tabulation.¹ High-temperature data primarily from Kelley.² Data for liquid estimated.

Melting

An average of five determinations used.

Vaporization

An average of five determinations used.

Further details by Barriault *et al.*³References

1. Hultgren, R. *et al.*, Selected Values of Thermodynamic Properties of Metals and Alloys, Wiley, New York (1963).
2. Kelley, K., U. S. Bur. Mines, Bull. 584 (1960).
3. Barriault, R. J. *et al.*, ASD TR 61-260 (May 1962), Pt. 1.

CHROMIUM (Cr)

(REFERENCE STATE)

GFW = 52.01

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	± 0.200	± 0.070	± 0.070	± 0.000			
311.65	± 0.200	± 0.080	± 0.070	± 0.003			
311.65	± 0.200	± 0.080	± 0.070	± 0.003			
1000	± 0.700	± 0.600	± 0.290	± 0.310			
1648	± 1.200	± 1.070	± 0.510	± 0.930			
1648	± 1.200	± 1.190	± 0.510	± 1.130			
2000	± 1.200	± 1.420	± 0.640	± 1.550			
2088	± 1.200	± 1.470	± 0.680	± 1.660			
2088	± 1.200	± 1.520	± 0.680	± 1.760			
2184	± 1.200	± 1.550	± 0.700	± 1.830			
2184	± 1.000	± 2.020	± 0.700	± 2.830			
2967	± 1.000	± 2.340	± 1.450	± 2.650			
2967	± 0.000	± 0.003					
3000	± 0.001						
4000	± 0.001	± 0.003					
5000	± 0.002	± 0.003					
6000	± 0.002	± 0.003					

TABLE 134

CHROMIUM

IDEAL MONATOMIC GAS

Cr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Cr from 0° to 2148°K,
Liquid Cr from 2148° to 2967°K, Gaseous Cr from 2967° to 6000°K.

T, °K	$\overset{\circ}{C}_p$	$\overset{\circ}{S}_T$	$\frac{\text{cal/}^\circ\text{K gfw}}{-(\overset{\circ}{F}_T - H_{298}^\circ)/T}$	$\overset{\circ}{H}_T - H_{298}^\circ$	$\overset{\circ}{\Delta H}_f$	$\overset{\circ}{\Delta F}_f$	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	94.309	94.309	INFINITE
298.15	4.968	41.637	41.637	0.000	94.820	84.099	-61.644
300	4.968	41.668	41.637	0.009	94.819	84.033	-61.215
311.65	4.968	41.857	41.642	0.067	94.810	83.615	-58.633
311.65	4.968	41.857	41.642	0.067	94.809	83.615	-58.633
400	4.968	43.097	41.832	0.506	94.731	80.452	-43.955
500	4.968	44.206	42.200	1.003	94.603	76.897	-33.610
600	4.968	45.111	42.612	1.500	94.450	73.369	-26.723
700	4.968	45.877	43.025	1.996	94.286	69.868	-21.813
800	4.969	46.561	43.424	2.493	94.103	66.393	-18.137
900	4.972	47.126	43.803	2.990	93.900	62.942	-15.284
1000	4.980	47.650	44.162	3.488	93.668	59.513	-13.006
1100	4.996	48.126	44.501	3.987	93.397	56.109	-11.147
1200	5.023	48.561	44.822	4.487	93.077	52.734	-9.604
1300	5.065	48.955	45.125	4.992	92.712	49.387	-8.302
1400	5.125	49.342	45.413	5.501	92.311	46.070	-7.191
1500	5.203	49.698	45.687	6.017	91.887	42.780	-6.233
1600	5.300	50.037	45.948	6.542	91.442	39.523	-5.398
1648	5.353	50.195	46.070	6.798	91.218	37.965	-5.034
1648	5.353	50.195	46.070	6.798	90.418	37.965	-5.034
1700	5.414	50.362	46.199	7.078	90.168	36.314	-4.668
1800	5.545	50.675	46.439	7.626	89.666	33.161	-4.026
1900	5.688	50.979	46.670	8.187	89.127	30.035	-3.455
2000	5.841	51.274	46.892	8.763	88.563	26.222	-2.865
2088	5.982	51.529	47.082	9.284	88.039	24.244	-2.537
2088	5.982	51.529	47.082	9.284	87.689	24.244	-2.537
2100	6.001	51.563	47.108	9.356	87.616	23.879	-2.485
2148	6.080	51.700	47.209	9.646	87.349	22.449	-2.284
2148	6.080	51.700	47.209	9.646	82.409	22.449	-2.284
2200	6.165	51.846	47.317	9.964	82.239	21.001	-2.086
2300	6.330	52.124	47.520	10.589	81.924	18.225	-1.732
2400	6.493	52.397	47.717	11.230	81.625	15.463	-1.408
2500	6.652	52.665	47.910	11.887	81.342	12.713	-1.111
2600	6.806	52.929	48.098	12.560	81.075	9.971	-0.838
2700	6.954	53.188	48.282	13.248	80.823	7.241	-0.586
2800	7.095	53.444	48.462	13.951	80.586	4.519	-0.353
2900	7.230	53.695	48.638	14.667	80.361	1.810	-0.136
2967	7.317	53.851	48.754	15.154	80.271	0.000	0.000
2967	7.317	53.851	48.754	15.154			
3000	7.359	53.943	48.810	15.396			
3100	7.481	54.186	48.980	16.138			
3200	7.599	54.425	49.146	16.892			
3300	7.713	54.661	49.310	17.658			
3400	7.825	54.893	49.471	18.435			
3500	7.935	55.121	49.629	19.223			
3600	8.045	55.346	49.785	20.022			
3700	8.157	55.568	49.938	20.832			
3800	8.270	55.787	50.089	21.653			
3900	8.386	56.004	50.238	22.486			
4000	8.506	56.217	50.385	23.331			
4100	8.631	56.429	50.529	24.188			
4200	8.761	56.638	50.672	25.057			
4300	8.896	56.846	50.814	25.940			
4400	9.036	57.052	50.953	26.837			
4500	9.183	57.257	51.091	27.747			
4600	9.335	57.460	51.227	28.673			
4700	9.492	57.663	51.362	29.615			
4800	9.654	57.864	51.495	30.572			
4900	9.821	58.065	51.627	31.546			
5000	9.992	58.265	51.758	32.536			
5100	10.167	58.465	51.888	33.544			
5200	10.346	58.664	52.016	34.570			
5300	10.524	58.863	52.143	35.613			
5400	10.705	59.061	52.270	36.675			
5500	10.887	59.259	52.395	37.754			
5600	11.069	59.457	52.519	38.852			
5700	11.250	59.655	52.643	39.968			
5800	11.429	59.852	52.765	41.102			
5900	11.605	60.049	52.887	42.254			
6000	11.779	60.245	53.008	43.423			

May 1962

CHW

CHROMIUM (Cr) (IDEAL MONATOMIC GAS) gfw = 52. 01

$$\Delta H_{f0}^{\circ} = 94. 309 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298. 15}^{\circ} = 94. 820 \text{ kcal gfw}^{-1}$$

Ground State Configuration = $7S_3$

$$S_{298. 15}^{\circ} = 41. 637 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298. 15}^{\circ} - H_0^{\circ} = 1. 481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Energy levels from Moore.¹

Heat of Formation

Vapor-pressure measurements from five sources used.

Heat Capacity and Entropy

Calculated using monatomic-gas program.

Further details by Barriault et al.²

References

1. Moore, C. Atomic Energy Levels, Vol. 2, Nat. Bur. Stds. (1952).
2. Barriault, R. et al., ASD TR 61-260 (May 1962), Pt. 1.

CHROMIUM, MONATOMIC (Cr)

(IDEAL GAS)

GFW = 52.01

SUMMARY OF UNCERTAINTY ESTIMATES

T °K	C_p	S_T	$-(F_T - H_{298}^{\circ})/T$	$H_T - H_{298}^{\circ}$	ΔH_f°	ΔS_f°	ΔG_f°
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 0.520	± 0.380
311.65	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 0.520	± 0.360
311.65	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 0.520	± 0.360
1000	± 0.000	± 0.002	± 0.002	± 0.000	± 0.810	± 0.790	± 0.170
1648	± 0.000	± 0.002	± 0.002	± 0.000	± 1.430	± 1.340	± 0.180
1648	± 0.000	± 0.002	± 0.002	± 0.000	± 1.630	± 1.340	± 0.180
2000	± 0.001	± 0.002	± 0.003	± 0.000	± 2.050	± 1.790	± 0.200
2088	± 0.001	± 0.002	± 0.003	± 0.000	± 2.160	± 1.930	± 0.200
2088	± 0.001	± 0.002	± 0.003	± 0.000	± 2.260	± 1.930	± 0.200
2148	± 0.001	± 0.002	± 0.003	± 0.001	± 2.330	± 2.010	± 0.200
2148	± 0.001	± 0.002	± 0.003	± 0.001	± 3.330	± 2.010	± 0.200
2967	± 0.001	± 0.003	± 0.003	± 0.001	± 3.150	± 4.810	± 0.350
2967	± 0.001	± 0.003	± 0.003	± 0.001			
3000	± 0.001	± 0.003	± 0.003	± 0.001			
4000	± 0.001	± 0.003	± 0.003	± 0.002			
5000	± 0.002	± 0.003	± 0.003	± 0.003			
6700	± 0.002	± 0.003	± 0.003	± 0.005			

TABLE 135

CHROMIUM MONOXIDE

IDEAL MOLECULAR GAS

CrO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Cr from 0° to 2148°K, Liquid Cr from 2148° to 2967°K, Gaseous Cr from 2967° to 6000°K, Gaseous O₂, Gaseous CrO.

T, °K	C_p	S_T	$(F_T - H_{298}^\circ)/T$	$H_T - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.440	49.567	49.567	INFINITE
298.15	8.288	56.689	56.689	0.000	50.000	42.098	-30.857
300	8.289	56.740	56.689	0.015	49.998	42.049	-30.631
311.65	8.296	57.057	56.697	0.112	49.987	41.744	-29.272
311.65	8.296	57.057	56.697	0.112	49.986	41.744	-29.272
400	8.397	59.138	57.015	0.849	49.893	39.416	-21.535
500	8.526	61.025	57.635	1.695	49.748	36.813	-16.090
600	8.635	62.590	58.334	2.554	49.579	34.241	-12.472
700	8.720	63.928	59.040	3.421	49.397	31.699	-9.896
800	8.786	65.096	59.725	4.297	49.194	29.185	-7.973
900	8.838	66.134	60.381	5.178	48.968	26.697	-6.483
1000	8.880	67.068	61.004	6.064	48.711	24.234	-5.296
1100	8.915	67.916	61.594	6.954	48.411	21.801	-4.331
1200	8.945	68.693	62.154	7.847	48.060	19.397	-3.532
1300	8.971	69.410	62.685	8.743	47.658	17.026	-2.862
1400	8.994	70.076	63.189	9.641	47.214	14.686	-2.292
1500	9.016	70.697	63.669	10.541	46.738	12.378	-1.803
1600	9.036	71.279	64.127	11.444	46.235	10.104	-1.380
1648	9.045	71.547	64.339	11.878	45.974	9.021	-1.196
1648	9.045	71.547	64.339	11.878	45.175	9.021	-1.196
1700	9.054	71.778	64.564	12.349	44.886	7.886	-1.014
1800	9.072	72.346	64.982	13.255	44.298	5.728	-0.695
1900	9.089	72.837	65.383	14.143	43.659	3.601	-0.414
2000	9.106	73.304	65.768	15.073	42.979	1.508	-0.165
2088	9.121	73.656	66.094	15.875	42.337	-0.303	0.032
2088	9.121	73.656	66.094	15.875	41.947	-0.303	0.032
2100	9.123	73.749	66.137	15.984	41.897	-0.540	0.056
2148	9.132	73.955	66.310	16.422	41.559	-1.489	0.151
2148	9.132	73.955	66.310	16.422	36.619	-1.489	0.151
2200	9.141	74.174	66.493	16.897	36.370	-2.402	0.239
2300	9.154	74.581	66.936	17.812	35.886	-4.154	0.395
2400	9.178	74.971	67.167	18.729	35.402	-5.887	0.536
2500	9.197	75.346	67.487	19.548	34.918	-7.595	0.664
2600	9.218	75.708	67.797	20.569	34.432	-9.290	0.781
2700	9.240	76.056	68.097	21.492	33.947	-10.962	0.887
2800	9.263	76.393	68.387	22.417	33.460	-12.617	0.985
2900	9.288	76.719	68.669	23.344	32.973	-14.251	1.074
2966.82	9.306	76.932	68.854	23.967	32.64	-15.345	1.130
2966.82	9.306	76.932	68.854	23.967	-47.572	-15.345	1.130
3000	9.315	77.035	68.943	24.274	-47.664	-14.976	1.091
3100	9.343	77.341	69.210	25.207	-47.771	-13.888	0.979
3200	9.373	77.634	69.464	26.143	-48.250	-12.786	0.973
3300	9.404	77.928	69.722	27.082	-48.560	-11.672	0.773
3400	9.438	78.210	69.968	28.024	-48.879	-10.550	0.678
3500	9.473	78.485	70.208	28.970	-49.208	-9.426	0.589
3600	9.510	78.753	70.442	29.919	-49.547	-8.287	0.503
3700	9.548	79.015	70.671	30.872	-49.895	-7.134	0.421
3800	9.589	79.271	70.894	31.829	-50.251	-5.977	0.344
3900	9.630	79.521	71.113	32.790	-50.618	-4.805	0.269
4000	9.674	79.766	71.328	33.755	-50.994	-3.644	0.199
4100	9.719	80.007	71.537	34.725	-51.379	-2.448	0.130
4200	9.765	80.243	71.743	35.700	-51.773	-1.256	0.065
4300	9.812	80.474	71.944	36.679	-52.179	-0.052	0.003
4400	9.861	80.702	72.142	37.663	-52.595	1.162	-0.058
4500	9.911	80.925	72.336	38.652	-53.022	2.381	-0.116
4600	9.962	81.145	72.526	39.647	-53.461	3.616	-0.172
4700	10.014	81.361	72.713	40.646	-53.915	4.855	-0.226
4800	10.067	81.574	72.897	41.651	-54.380	6.101	-0.278
4900	10.120	81.784	73.077	42.662	-54.860	7.360	-0.328
5000	10.175	81.991	73.255	43.678	-55.354	8.630	-0.377
5100	10.230	82.195	73.430	44.699	-55.866	9.909	-0.425
5200	10.286	82.396	73.602	45.727	-56.394	11.196	-0.471
5300	10.343	82.595	73.772	46.760	-56.941	12.492	-0.515
5400	10.400	82.791	73.939	47.800	-57.506	13.797	-0.558
5500	10.457	82.984	74.104	48.844	-58.093	15.109	-0.600
5600	10.515	83.176	74.266	49.897	-58.702	16.442	-0.642
5700	10.574	83.365	74.426	50.954	-59.338	17.778	-0.682
5800	10.633	83.553	74.584	52.018	-59.999	19.128	-0.721
5900	10.692	83.738	74.740	53.089	-60.689	20.485	-0.759
6000	10.751	83.921	74.894	54.165	-61.418	21.852	-0.796

15 September 1962

CIW

CHROMIUM MONOXIDE (CrO) (IDEAL MOLECULAR GAS) gfw = 68.01

$$\Delta H_{f0} = 49.567 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 50.000 \text{ Kcal gfw}^{-1}$$

Ground State Configuration ${}^1\Sigma$

$$S_{298.15}^{\circ} = 56.689 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.440 \text{ Kcal gfw}^{-1}$$

Spectroscopic constants for ten electronic levels from Herzberg¹ were used.
See text for details.

Heat of Formation

Based on work of Grimley et al².

Heat and Capacity and Entropy

Calculated on diatomic gas computer program.

References

1. Herzberg, G., Molecular Spectra and Molecular Structure I., Van Nostrand, N. Y. (1950).
2. Grimley, R., et al. J. Chem. Phys. 34, 664 (1961).

TABLE 136

CHROMIUM DIOXIDE

CONDENSED PHASE

CrO₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Cr from 0° to 2148°K,
Liquid Cr from 2148° to 2967°K, Gaseous Cr from 2967 to 6000°K; Gaseous O₂;
Solid CrO₂.

T, °K	cal/°K gfw			Kcal/gfw			Log Kp
	C_p°	S_T°	$-(H_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
0	0.000	0.000	INFINITE	-1.900	-138.855	-138.855	INFINITE
298.15	13.380	9.900	9.900	0.000	-140.000	-126.647	27.677
300	13.430	9.983	9.903	0.024	-139.999	-126.600	27.667
311.65	13.670	10.501	9.914	0.183	-139.990	-126.034	27.543
311.65	13.670	10.501	9.914	0.183	-139.991	-126.034	27.543
400	15.070	14.094	10.451	1.457	-139.861	-122.102	26.684
500	16.150	17.584	11.542	3.021	-139.653	-117.687	25.719
600	17.000	20.602	12.802	4.680	-139.400	-113.315	24.764
700	17.740	23.279	14.112	6.417	-139.100	-108.991	23.819
800	18.430	25.693	15.410	8.226	-138.769	-104.711	22.883

15 September 1962

CHW

CHROMIUM DIOXIDE (CrO₂) (CONDENSED PHASE) gfw = 84.01

$$\Delta H^{\circ}_{f298.15} = -140.000 \text{ Kcal gfw}^{-1} \quad S^{\circ}_{298.15} = 9.900 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^{\circ}_{298.15} - H^{\circ}_0 = 1.900 \text{ Kcal gfw}^{-1}$$

$$C^{\circ}_p = 14.13 + 5.80 \times 10^{-3} T - 2.20 \times 10^{-5} T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15 \text{ }^{\circ}\text{K} \leq T \leq 800 \text{ }^{\circ}\text{K}$$

Structure

CrO₂ is considered to remain solid until decomposition occurs near 800°K.

Heat of Formation

Based on work of Ariya et al.¹

Heat Capacity and Entropy

Data were estimated.

References

1. Ariya, S., et al., J. Gen. Chem. USSR 23, 1307 (1953).

TABLE 117

CHROMIUM DIOXIDE

IDEAL MOLECULAR GAS

CrO₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p: Solid Cr from 0° to 2148°K,
Liquid Cr from 2148° to 2967°K, Gaseous Cr from 2967° to 6000°K, Gaseous O₂:
Gaseous CrO₂.

T, °K	C_p	S_T	$\frac{\text{cal/}^\circ\text{K gfw}}{-(F_T^\circ - H_{298}^\circ)/T}$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K _p
0	0.000	0.000	INFINITE	-2.640	-18.595	-18.595	INFINITE
298.15	10.453	61.856	61.856	0.000	-19.000	-21.137	15.493
300	10.473	61.921	61.856	0.019	-19.004	-21.150	15.407
311.65	10.599	62.322	61.866	0.142	-19.031	-21.225	14.884
311.65	10.599	62.322	61.866	0.142	-19.032	-21.225	14.884
400	11.422	65.071	62.279	1.117	-19.201	-21.833	11.928
500	12.085	67.696	63.107	2.294	-19.380	-22.470	9.821
600	12.537	69.942	64.064	3.527	-19.553	-23.072	8.403
700	12.849	71.899	65.046	4.797	-19.720	-23.645	7.382
800	13.070	73.630	66.013	6.093	-19.902	-24.194	6.609
900	13.230	75.179	66.947	7.409	-20.100	-24.719	6.002
1000	13.350	76.580	67.842	8.738	-20.329	-25.220	5.512
1100	13.441	77.857	68.695	10.078	-20.598	-25.697	5.105
1200	13.512	79.029	69.508	11.426	-20.918	-26.146	4.762
1300	13.569	80.113	70.282	12.780	-21.291	-26.566	4.466
1400	13.614	81.120	71.021	14.139	-21.706	-26.958	4.208
1500	13.651	82.061	71.726	15.502	-22.153	-27.318	3.980
1600	13.681	82.943	72.400	16.869	-22.633	-27.646	3.776
1648	13.694	83.348	72.713	17.526	-22.880	-27.798	3.686
1648	13.694	83.348	72.713	17.526	-23.680	-27.798	3.686
1700	13.707	83.773	73.045	18.239	-23.956	-27.921	3.589
1800	13.728	84.557	73.663	19.610	-24.524	-28.138	3.416
1900	13.747	85.300	74.256	20.984	-25.144	-28.321	3.258
2000	13.762	86.006	74.826	22.360	-25.808	-28.470	3.111
2088	13.774	86.599	75.310	23.571	-26.439	-28.576	2.991
2088	13.774	86.599	75.310	23.571	-26.789	-28.576	2.991
2100	13.776	86.677	75.374	23.737	-26.877	-28.581	2.974
2148	13.782	86.989	75.630	24.398	-27.210	-28.594	2.909
2148	13.782	86.989	75.630	24.398	-32.150	-28.594	2.909
2200	13.788	87.319	75.903	25.115	-32.395	-28.551	2.831
2300	13.798	87.932	76.413	26.494	-32.872	-28.315	2.690
2400	13.807	88.519	76.905	27.874	-33.354	-28.106	2.559
2500	13.814	89.083	77.381	29.256	-33.840	-27.878	2.437
2600	13.822	89.625	77.841	30.637	-34.331	-27.628	2.322
2700	13.829	90.147	78.288	32.020	-34.827	-27.365	2.215
2800	13.834	90.650	78.720	33.403	-35.3	-27.076	2.113
2900	13.840	91.135	79.140	34.787	-35.805	-26.773	2.018
2966.82	13.843	91.451	79.414	35.714	-36.170	-26.561	1.956
2966.82	13.843	91.451	79.414	35.714	-116.389	-26.561	1.956
3000	13.844	91.605	79.548	36.171	-116.488	-26.554	1.862
3100	13.848	92.059	79.944	37.556	-116.802	-22.515	1.587
3200	13.852	92.448	80.329	38.941	-117.133	-19.472	1.330
3300	13.856	92.925	80.705	40.326	-117.479	-16.414	1.087
3400	13.859	93.338	81.070	41.712	-117.840	-13.342	0.858
3500	13.862	93.740	81.426	43.098	-118.216	-10.262	0.641
3600	13.864	94.131	81.774	44.484	-118.607	-7.178	0.436
3700	13.867	94.511	82.113	45.871	-119.011	-4.074	0.241
3800	13.869	94.880	82.444	47.258	-119.430	-0.961	0.055
3900	13.871	95.241	82.768	48.645	-119.865	2.165	-0.121
4000	13.873	95.592	83.084	50.032	-120.315	5.296	-0.289
4100	13.875	95.936	83.393	51.419	-120.781	8.446	-0.450
4200	13.877	96.269	83.696	52.807	-121.262	11.600	-0.604
4300	13.878	96.595	83.992	54.195	-121.760	14.771	-0.751
4400	13.880	96.914	84.282	55.582	-122.278	17.956	-0.892
4500	13.881	97.226	84.566	56.970	-122.811	21.150	-1.027
4600	13.882	97.532	84.845	58.359	-123.364	24.357	-1.157
4700	13.884	97.830	85.118	59.747	-123.939	27.570	-1.282
4800	13.885	98.122	85.386	61.135	-124.535	30.806	-1.403
4900	13.886	98.409	85.649	62.524	-125.153	34.045	-1.518
5000	13.887	98.689	85.907	63.912	-125.796	37.305	-1.631
5100	13.888	98.964	86.160	65.301	-126.465	40.576	-1.739
5200	13.889	99.234	86.409	66.690	-127.162	43.857	-1.843
5300	13.889	99.498	86.653	68.079	-127.889	47.159	-1.945
5400	13.890	99.758	86.894	69.468	-128.650	50.463	-2.042
5500	13.891	100.013	87.130	70.857	-129.445	53.796	-2.138
5600	13.892	100.263	87.362	72.246	-130.281	57.137	-2.230
5700	13.892	100.509	87.591	73.635	-131.160	60.500	-2.320
5800	13.893	100.751	87.816	75.024	-132.089	63.870	-2.407
5900	13.893	100.988	88.037	76.414	-133.072	67.266	-2.492
6000	13.894	101.222	88.255	77.803	-134.117	70.668	-2.574

15 September 1962

CHW

CHROMIUM DIOXIDE (CrO₂) (IDEAL MOLECULAR GAS) gfw = 84.01

$$\Delta H_{f0}^{\circ} = -18.595 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -19.000 \text{ kcal gfw}^{-1}$$

Point Group = C_{2v}

$$S_{298.15}^{\circ} = 61.856 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.640 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
870 (1)	926 (1)
388 (1)	

Bond lengths and angles:

Cr-O distance = 1.627 Å

O-Cr-O angle = 107°

Product of moments of inertia:

$$I_A I_B I_C = 3.40637 \times 10^{-115} \text{ g}^3 \text{ cm}^6 \quad \sigma = 2$$

Heat of Formation

Based on mass-spectrometric work of Grimley et al¹.

Heat Capacity and Entropy

Calculated using estimated spectroscopic constants.

Reference

1. Grimley, R. T. et al, J. Chem. Phys. 34, 664 (1961).

TABLE 138

CHROMIUM TRIOXIDE

CONDENSED PHASE



Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Cr from 0° to 2148°K,
 Liquid Cr from 1967°K, Gaseous Cr from 2967 to 6800°K, Gaseous O_2 ,
 Solid CrO_3 from 0° to 470°K, Liquid CrO_3 from 470° to 800°K

T, °K	ϵ_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-2.970	-140.288	-140.288	INFINITE
298.15	18.090	18.260	18.260	0.000	-141.400	-123.234	90.328
300	18.130	18.371	18.260	0.034	-141.396	-123.121	89.689
311.65	18.390	19.067	18.274	0.247	-141.374	-122.398	85.830
311.65	18.390	19.067	18.274	0.247	-141.375	-122.398	85.830
400	19.930	23.853	18.993	1.944	-141.135	-117.062	63.956
470	20.840	27.141	19.967	3.372	-140.914	-117.853	52.474
470	29.000	38.541	19.967	8.730	-135.556	-117.853	52.474
500	29.000	40.336	21.136	9.600	-135.201	-111.431	48.704
600	29.000	45.623	24.790	12.500	-134.085	-106.782	38.893
700	29.000	50.093	28.093	15.400	-133.010	-102.318	31.943
800	29.000	53.966	31.091	18.300	-131.998	-98.004	26.772

15 September 1962

CHW

CHROMIUM TRIOXIDE (CrO₃) (CONDENSED PHASE) gfw = 100.01

$$\Delta H_{f298.15}^{\circ} = -141.400 \text{ kcal gfw}^{-1} \quad S_{298.15}^{\circ} = 18.260 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 470^{\circ}\text{K}$$

$$\Delta H_m = 5.358 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.970 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 18.12 + 7.80 \times 10^{-3}T - 2.10 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 470^{\circ}\text{K}$$

$$C_p^{\circ} = 29.00 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$470^{\circ}\text{K} \leq T \leq 800^{\circ}\text{K}$$

Structure

See volume 1, this study (section IVB6.4.3) for details.

Heat of Formation

The value of ΔH_m° adopted.

Heat Capacity and Entropy

An equation estimated in an analogous manner to that used for CrO_{2(s)}.

Melting and Vaporization

See volume 1, this study (section IVB6.4.3) for details.

Reference

1. Mah, A. D., J. Am. Chem. Soc. 76, 3363 (1954).

TABLE 1-4

CHROMIUM TRIOXIDE

DIATOMICULAR GAS

CrO₃

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Cr from 0° to 2148°K, Liquid Cr from 2148° to 2967°K, Gaseous Cr from 2967° to 6000°K, Gaseous O₂, Gaseous CrO₃

T, °K	C_p	S_T	G_T	H_{298}/T	$H_T - H_{298}$	ΔH_f	ΔF_f	$\log K_p$
0	0.000	0.000	INFINITE	-3.108	-67.426	-67.426	INFINITE	
298.15	13.881	64.500	64.500	0.000	-68.400	-64.020	46.926	
300	13.916	64.586	64.500	0.026	-68.404	-63.993	46.616	
311.65	14.104	65.201	64.566	0.198	-68.423	-63.825	44.756	
311.65	14.104	65.201	64.566	0.198	-68.424	-63.825	44.756	
400	15.533	68.824	65.067	1.503	-68.576	-62.491	34.142	
500	16.663	72.419	66.187	3.116	-68.685	-60.956	26.643	
600	17.441	75.530	67.491	4.824	-68.761	-59.407	21.636	
700	17.984	78.262	68.819	6.596	-68.814	-57.840	18.057	
800	18.371	80.670	70.171	8.415	-68.873	-56.268	15.371	
900	18.654	82.871	71.463	10.267	-68.941	-54.689	13.280	
1000	18.867	84.848	72.704	12.144	-69.036	-53.099	11.604	
1100	19.029	86.654	73.892	14.039	-69.170	-51.499	10.231	
1200	19.156	88.316	75.025	15.948	-69.353	-49.885	9.085	
1300	19.257	89.853	76.108	17.867	-69.587	-48.253	8.112	
1400	19.338	91.283	77.141	19.799	-69.863	-46.603	7.275	
1500	19.404	92.620	78.129	21.736	-70.172	-44.933	6.546	
1600	19.459	93.874	79.074	23.679	-70.514	-43.237	5.906	
1648	19.481	94.445	79.509	24.615	-70.694	-42.416	5.625	
1648	19.481	94.445	79.509	24.615	-71.494	-42.416	5.625	
1700	19.505	95.065	79.980	25.628	-71.700	-41.499	5.335	
1800	19.543	96.171	80.849	27.580	-72.131	-39.710	4.821	
1900	19.576	97.224	81.683	29.536	-72.616	-37.894	4.359	
2000	19.605	98.233	82.486	31.495	-73.147	-36.052	3.939	
2088	19.626	99.077	83.166	33.222	-73.661	-34.408	3.601	
2088	19.626	99.077	83.166	33.222	-74.011	-34.408	3.601	
2100	19.629	99.191	83.255	33.457	-74.084	-34.178	3.557	
2148	19.639	99.612	83.617	34.400	-74.354	-33.240	3.382	
2148	19.639	99.612	83.617	34.400	-79.294	-33.240	3.382	
2200	19.650	100.104	84.004	35.421	-79.472	-32.120	3.191	
2300	19.669	100.976	84.723	37.387	-79.820	-29.960	2.847	
2400	19.685	101.816	85.418	39.355	-80.174	-27.787	2.530	
2500	19.700	102.619	86.090	41.324	-80.537	-25.598	2.238	
2600	19.713	103.392	86.741	43.295	-80.904	-23.392	1.966	
2700	19.724	104.137	87.377	45.266	-81.281	-21.171	1.714	
2800	19.734	104.854	87.983	47.239	-81.661	-18.936	1.478	
2900	19.744	105.547	88.577	49.213	-82.044	-16.692	1.258	
2966.82	19.749	105.997	88.964	50.536	-82.315	-15.179	1.180	
2966.82	19.749	105.997	88.964	50.536	-162.532	-15.179	1.180	
3000	19.752	106.216	89.154	51.188	-162.592	-13.536	0.986	
3100	19.767	106.864	89.714	53.164	-162.794	-8.553	0.603	
3200	19.766	107.491	90.260	55.140	-163.015	-3.484	0.245	
3300	19.773	108.100	90.792	57.117	-163.251	1.406	-0.093	
3400	19.779	108.690	91.309	59.094	-163.507	6.399	-0.411	
3500	19.784	109.264	91.814	61.071	-163.776	11.403	-0.712	
3600	19.789	109.821	92.307	63.051	-164.055	16.409	-0.996	
3700	19.793	110.367	92.787	65.030	-164.367	21.430	-1.266	
3800	19.797	110.891	93.257	67.010	-164.685	26.452	-1.521	
3900	19.801	111.405	93.716	68.990	-165.022	31.496	-1.765	
4000	19.804	111.907	94.164	70.970	-165.375	36.532	-1.996	
4100	19.808	112.396	94.603	72.951	-165.745	41.586	-2.217	
4200	19.811	112.873	95.032	74.931	-166.134	46.649	-2.427	
4300	19.814	113.339	95.453	76.913	-166.539	51.720	-2.629	
4400	19.816	113.795	95.864	78.894	-166.968	56.808	-2.822	
4500	19.819	114.240	96.268	80.876	-167.412	61.893	-3.006	
4600	19.821	114.676	96.663	82.858	-167.880	67.004	-3.183	
4700	19.823	115.102	97.051	84.840	-168.372	72.112	-3.353	
4800	19.825	115.520	97.431	86.823	-168.886	77.242	-3.517	
4900	19.827	115.928	97.805	88.805	-169.428	82.369	-3.674	
5000	19.829	116.329	98.171	90.788	-169.996	87.520	-3.825	
5100	19.831	116.722	98.531	92.771	-170.596	92.677	-3.971	
5200	19.833	117.107	98.885	94.754	-171.229	97.843	-4.112	
5300	19.834	117.484	99.232	96.737	-171.899	103.027	-4.248	
5400	19.835	117.855	99.574	98.721	-172.609	108.221	-4.380	
5500	19.836	118.219	99.909	100.704	-173.362	113.443	-4.508	
5600	19.838	118.577	100.239	102.688	-174.167	118.664	-4.631	
5700	19.839	118.928	100.564	104.672	-175.027	123.912	-4.751	
5800	19.840	119.273	100.884	106.656	-175.953	129.166	-4.867	
5900	19.841	119.612	101.198	108.640	-176.917	134.449	-4.980	
6000	19.842	119.945	101.508	110.624	-178.035	139.740	-5.090	

12 September 1962

CHW

CHROMIUM TRIOXIDE (CrO₃) (IDEAL MOLECULAR GAS) gfw = 100.01

$$\Delta H_{f0}^{\circ} = -67.426 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -68.400 \text{ kcal gfw}^{-1}$$

Point Group = D_{3h}

$$S_{298.15}^{\circ} = 64.500 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.108 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
840 (1)	1023 (2)
397 (1)	374 (2)

Bond lengths and angles:

$$\text{Cr-O distance} = 1.627 \text{ \AA}$$

$$\text{O-Cr-O angle} = 120^{\circ}$$

Product of moments of inertia:

$$I_A I_B I_C = 2.34688 \times 10^{-114} \text{ g}^3 \text{ cm}^6 \quad \sigma = 6$$

Heat of Formation

Based on the mass-spectrometric data of Grimley et al¹

Heat Capacity and Entropy

Calculated from estimated spectroscopic constants.

Reference

1. Grimley, R. T., R. P. Burns, and M. G. Inghram, J. Chem. Phys. 34, 664 (1961).

TABLE 140

HAFNIUM

REFERENCE STATE

Hf

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Hf from 0° to 2495°K,
Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K

T, °K	C_p	ΔH_f° Kcal./K gfw	ΔF_f° Kcal./K gfw	ΔH_f° Kcal./K gfw	ΔF_f° Kcal./K gfw	$\log K_p$
0	0.000	0.000	INFINITE	-1.435		
298.15	6.390	10.710	10.710	0.000		
300	6.400	10.750	10.710	0.012		
400	6.850	12.654	10.964	0.676		
500	7.162	14.215	11.460	1.378		
600	7.332	15.536	11.930	2.103		
700	7.502	16.678	12.613	2.845		
800	7.672	17.692	13.188	3.603		
900	7.842	18.605	13.740	4.379		
1000	8.011	19.440	14.269	5.172		
1100	8.181	20.212	14.774	5.981		
1200	8.350	20.931	15.258	6.807		
1300	8.519	21.607	15.721	7.652		
1400	8.689	22.244	16.164	8.512		
1500	8.859	22.850	16.590	9.389		
1600	9.028	23.427	16.999	10.284		
1700	9.198	23.979	17.394	11.195		
1800	9.368	24.510	17.774	12.123		
1900	9.537	25.021	18.142	13.069		
2000	9.707	25.514	18.499	14.031		
2033	9.764	25.673	18.614	14.352		
2033	9.764	26.485	18.614	16.002		
2100	9.871	26.803	18.870	16.660		
2200	10.046	27.267	19.241	17.656		
2300	10.216	27.717	19.670	18.669		
2400	10.386	28.155	19.947	19.699		
2495	10.547	28.562	20.268	20.694		
2495	8.000	30.662	20.268	25.933		
2495	8.000	30.678	20.289	25.973		
2600	8.000	30.991	20.694	26.773		
2700	8.000	31.293	21.081	27.573		
2800	8.000	31.584	21.451	28.373		
2900	8.000	31.865	21.805	29.173		
3000	8.000	32.136	22.145	29.973		
3100	8.000	32.398	22.472	30.773		
3200	8.000	32.652	22.786	31.573		
3300	8.000	32.899	23.089	32.373		
3400	8.000	33.137	23.381	33.173		
3500	8.000	33.369	23.663	33.973		
3600	8.000	33.595	23.936	34.773		
3700	8.000	33.814	24.200	35.573		
3800	8.000	34.027	24.456	36.373		
3900	8.000	34.235	24.704	37.173		
4000	8.000	34.438	24.944	37.973		
4100	8.000	34.635	25.178	38.773		
4200	8.000	34.828	25.406	39.573		
4300	8.000	35.016	25.627	40.373		
4400	8.000	35.200	25.843	41.173		
4500	8.000	35.380	26.053	41.973		
4600	8.000	35.556	26.255	42.773		
4700	8.000	35.728	26.457	43.573		
4800	8.000	35.896	26.652	44.373		
4900	8.000	36.061	26.842	45.173		
4985.40	8.000	36.200	27.001	45.856		
4985.40	8.885	62.936	27.001	179.152		
5000	8.898	62.962	27.106	179.282		
5100	8.988	63.139	27.811	180.176		
5200	9.078	63.315	28.492	181.080		
5300	9.167	63.488	29.150	181.992		
5400	9.257	63.661	29.788	182.913		
5500	9.337	63.831	30.405	183.842		
5600	9.419	64.000	31.004	184.780		
5700	9.490	64.167	31.584	185.726		
5800	9.578	64.333	32.147	186.680		
5900	9.653	64.498	32.695	187.641		
6000	9.725	64.661	33.226	188.610		

15 March 1964

HLS

0°K to 2495°K
2495°K to 4985.40°K
4985.40°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^0 = 0$$

$$\Delta H_{(298.15)}^0 = 0$$

$$\Delta H_{(298.15)}^0 = 144.924 \text{ Kcal gfw}^{-1}$$

$$S_{(298.15)}^0 = 10.710 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_f = 2033^\circ\text{K}$$

$$\Delta H_f = 1.650 \pm 0.200 \text{ Kcal gfw}^{-1}$$

$$T_m = 2495^\circ\text{K}$$

$$\Delta H_m = 5.249 \pm 1.000 \text{ Kcal gfw}^{-1}$$

$$T_b = 4985.40^\circ\text{K}$$

$$\Delta H_v = 133.296 \text{ Kcal gfw}^{-1}$$

$$H_{(298.15)}^0 - H_0^0 = 1.435 \text{ Kcal gfw}^{-1}$$

$$C_p^0 = 6.3147 + 1.69646 \times 10^{-3} \text{ cal degK}^{-1} \text{ gfw}^{-1} \text{ was used from } 500^\circ \text{ to } 2495^\circ\text{K}$$

Structure

H C P up to 2033°K, B C C from 2033° to 2495°K

Heat of Formation

Zero by definition

Heat Capacity and Entropy

Low-temperature data of Burk et al.¹ was joined onto Fieldhouse and Lang's² high temperature data.

Melting

See Barriault et al.³

Heat of Sublimation

An average of two determinations. See volume 1, this study (section IVA9) for details.

References

1. Burk, D. L., I. Esterman and S. A. Friedberg, Z. Physik Chem. Neue Folge 16, 183 (1958).
2. Fieldhouse, I. B. and J. Lang, WADD TR-60-904 (July 1961) and private communication.
3. Barriault, R. J. et al., Thermodynamics of Certain Refractory Compounds Pt. I, Vol. 1, ASD TR-61-260 (May 1962).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	ΔH_f K gfw			ΔH_f K gfw			ΔH_f	ΔH_f
	C_f	S_f	$-H_f$	$H_{(298.15)}^0$	H_f	$H_{(298.15)}^0$	ΔH_f	ΔH_f
298.15	±0.100	±0.050	±0.050	±0.000				
500	±0.100	±0.102	±0.061	±0.020				
500	±0.500	±0.102	±0.061	±0.020				
1000	±0.500	±0.448	±0.178	±0.270				
1500	±0.500	±0.651	±0.304	±0.520				
1500	±1.000	±0.651	±0.304	±0.520				
2000	±1.000	±0.939	±0.429	±1.020				
2033	±1.000	±0.955	±0.437	±1.053				
2033	±1.000	±1.053	±0.437	±1.253				
2495	±1.000	±1.258	±0.571	±1.715				
2495	±2.000	±1.659	±0.571	±2.715				
3000	±2.000	±2.028	±0.786	±3.725				
4000	±2.000	±2.603	±1.172	±5.725				
4985.40	±2.000	±3.043	±1.500	±7.696				

TABLL 141

HAFFNIUM

IDEAL MONATOMIC GAS

Hf

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Hf from 0° to 2495°K,
Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K

T, °K	C_p	S_T	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-1.481	144.878	144.878	INFINITE
298.15	4.972	44.645	44.645	0.000	144.924	134.806	-98.811
300	4.973	44.675	44.645	0.009	144.921	134.743	-98.156
400	5.010	46.110	44.840	0.508	144.756	131.374	-71.776
500	5.114	47.237	45.211	1.013	144.559	128.048	-55.967
600	5.285	48.184	45.629	1.533	144.354	124.765	-45.443
700	5.500	49.015	46.055	2.072	144.151	121.515	-37.937
800	5.734	49.764	46.472	2.634	143.955	118.297	-32.316
900	5.970	50.453	46.877	3.219	143.764	115.101	-27.949
1000	6.196	51.094	47.267	3.827	143.579	111.926	-24.460
1100	6.407	51.695	47.642	4.458	143.401	108.769	-21.609
1200	6.596	52.260	48.004	5.108	143.225	105.629	-19.232
1300	6.763	52.795	48.352	5.776	143.048	102.504	-17.232
1400	6.906	53.302	48.688	6.460	142.872	99.390	-15.515
1500	7.026	53.782	49.011	7.157	142.692	96.293	-14.029
1600	7.123	54.239	49.324	7.864	142.504	93.204	-12.730
1700	7.201	54.673	49.626	8.581	142.310	90.130	-11.586
1800	7.260	55.087	49.918	9.304	142.105	87.065	-10.571
1900	7.305	55.481	50.200	10.032	141.887	84.014	-9.663
2000	7.338	55.856	50.474	10.764	141.657	80.974	-8.848
2033	7.346	55.976	50.562	11.007	141.579	79.974	-8.597
2033	7.346	55.976	50.562	11.007	139.929	79.974	-8.597
2100	7.361	56.215	50.719	11.499	139.763	77.999	-8.117
2200	7.378	56.558	50.946	12.236	139.504	75.063	-7.456
2300	7.391	56.886	51.245	12.975	139.230	72.141	-6.855
2400	7.401	57.201	51.486	13.714	138.939	69.230	-6.304
2495	7.411	57.488	51.709	14.418	138.648	66.479	-5.823
2495	7.411	57.488	51.709	14.418	133.409	66.479	-5.823
2500	7.411	57.503	51.721	14.455	133.406	66.344	-5.800
2600	7.423	57.794	51.949	15.197	133.348	63.661	-5.351
2700	7.436	58.074	52.171	15.940	133.291	60.981	-4.936
2800	7.453	58.345	52.386	16.684	133.235	58.306	-4.551
2900	7.474	58.607	52.596	17.430	133.181	55.630	-4.192
3000	7.499	58.861	52.801	18.179	133.130	52.956	-3.858
3100	7.530	59.107	53.000	18.930	133.041	50.287	-3.545
3200	7.565	59.347	53.195	19.685	133.000	47.615	-3.252
3300	7.606	59.580	53.385	20.444	132.995	44.947	-2.977
3400	7.653	59.808	53.571	21.207	132.958	42.278	-2.717
3500	7.704	60.030	53.752	21.974	132.925	39.613	-2.473
3600	7.761	60.248	53.929	22.748	132.899	36.949	-2.243
3700	7.822	60.462	54.103	23.527	132.878	34.283	-2.025
3800	7.889	60.671	54.273	24.312	132.863	31.619	-1.818
3900	7.959	60.877	54.440	25.105	132.856	28.954	-1.622
4000	8.033	61.079	54.603	25.904	132.855	26.288	-1.436
4100	8.111	61.279	54.764	26.711	132.862	23.621	-1.259
4200	8.191	61.475	54.921	27.526	132.877	20.961	-1.091
4300	8.275	61.669	55.076	28.350	132.901	18.293	-0.930
4400	8.360	61.860	55.228	29.181	132.932	15.630	-0.776
4500	8.448	62.049	55.377	30.022	132.973	12.966	-0.630
4600	8.537	62.235	55.524	30.871	133.022	10.296	-0.489
4700	8.627	62.420	55.669	31.729	133.080	7.628	-0.355
4800	8.717	62.603	55.812	32.596	133.147	4.956	-0.226
4900	8.808	62.783	55.952	33.473	133.224	2.285	-0.102
4985.40	8.885	62.936	56.071	34.228	133.296	0.000	0.000
4985.40	8.885	62.936	56.071	34.228	133.296	0.000	0.000
5000	8.898	62.962	56.091	34.358			
5100	8.988	63.139	56.227	35.252			
5200	9.078	63.315	56.362	36.156			
5300	9.166	63.488	56.494	37.068			
5400	9.252	63.661	56.626	37.989			
5500	9.337	63.831	56.755	38.918			
5600	9.419	64.000	56.883	39.856			
5700	9.500	64.167	57.009	40.802			
5800	9.578	64.333	57.134	41.756			
5900	9.653	64.498	57.258	42.717			
6000	9.725	64.661	57.380	43.686			

15 March 1963

HL5

$$\Delta H_{f0}^{\circ} = 144.878 \text{ Kcal gfw}^{-1}$$

Ground State Configuration 3F_2

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 144.924 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 44.645 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

Data from earlier report¹ using levels from Moore² were used.

Heat of Formation

Vapor-pressure data from two sources were used and averaged. Volume 1, this report (section IVA9) contains additional details.

Heat Capacity and Entropy

Calculated on monatomic gas program

References

1. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds, Pt. I, Vol. 1, ASD TR-61-260 (May 1962).
2. Moore, C., Atomic Energy Levels, Vol. 3, Nat. Bur. Std. (U S.), Circ. 467 (1958)

HAFNIUM, MONATOMIC (Hf)

(IDEAL GAS)

GFW = 178.50

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	$\log K_p$
298.15	±0.000	±0.002	±0.002	±0.000	±3.000		
1000	±0.001	±0.002	±0.003	±0.000			
2000	±0.001	±0.003	±0.003	±0.001			
2033	±0.001	±0.003	±0.003	±0.001			
2033	±0.001	±0.003	±0.003	±0.001			
2495	±0.001	±0.003	±0.003	±0.001			
2495	±0.001	±0.003	±0.003	±0.001			
3000	±0.001	±0.003	±0.003	±0.001			
4000	±0.003	±0.003	±0.003	±0.003			
5000	±0.006	±0.004	±0.003	±0.007			
6000	±0.011	±0.006	±0.003	±0.015			

TABLE 142

HAFNIUM NITRIDE

CONDENSED PHASE

HfN

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Hf from 0° to 2495°K,
 Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K;
 Gaseous N₂; Solid HfN from 0° to 3583°K, Liquid HfN from 3583° to 6000°K

T, °K	C_p	C_p	$-(F_T - H_{298})/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.773	-87.542	-87.542	INFINITE
298.15	9.800	10.700	10.700	0.000	-88.240	-81.414	59.675
300	9.826	10.761	10.700	0.018	-88.240	-81.371	59.276
400	10.827	13.741	11.100	1.056	-88.215	-79.085	43.208
500	11.409	16.224	11.883	2.170	-88.154	-76.811	33.572
600	11.828	18.342	12.788	3.333	-88.073	-74.552	27.154
700	12.168	20.192	13.714	4.533	-87.978	-72.306	22.574
800	12.467	21.837	14.630	5.765	-87.876	-70.072	19.142
900	12.743	23.321	15.515	7.026	-87.771	-67.853	16.476
1000	13.003	24.677	16.364	8.313	-87.664	-65.645	14.346
1100	13.253	25.928	17.177	9.626	-87.554	-63.449	12.605
1200	13.497	27.092	17.956	10.964	-87.442	-61.262	11.157
1300	13.736	28.182	18.701	12.325	-87.337	-59.084	9.932
1400	13.972	29.209	19.415	13.711	-87.216	-56.916	8.885
1500	14.205	30.180	20.101	15.120	-87.099	-54.756	7.978
1600	14.436	31.105	20.760	16.552	-86.982	-52.604	7.185
1700	14.666	31.987	21.394	18.007	-86.857	-50.458	6.486
1800	14.895	32.831	22.007	19.485	-86.731	-48.322	5.867
1900	15.123	33.643	22.598	20.986	-86.603	-46.192	5.313
2000	15.350	34.424	23.170	22.509	-86.471	-44.067	4.815
2033	15.424	34.676	23.354	23.017	-86.426	-43.367	4.662
2033	15.424	34.676	23.354	23.017	-88.076	-43.367	4.662
2100	15.576	35.179	23.724	24.056	-87.983	-41.897	4.360
2200	15.802	35.909	24.261	25.625	-87.843	-40.005	4.272
2300	16.027	36.616	24.783	27.216	-87.699	-37.519	3.565
2400	16.253	37.303	25.290	28.830	-87.551	-35.342	3.218
2495	16.466	37.938	25.760	30.384	-87.407	-33.276	2.915
2495	16.466	37.938	25.760	30.384	-92.646	-33.276	2.915
2500	16.477	37.971	25.784	30.467	-92.625	-33.156	2.898
2600	16.707	38.622	26.260	32.126	-92.204	-30.789	2.588
2700	16.926	39.256	26.735	33.807	-91.762	-28.435	2.302
2800	17.151	39.876	27.193	35.511	-91.298	-26.097	2.037
2900	17.375	40.481	27.641	37.237	-90.814	-23.777	1.792
3000	17.599	41.074	28.079	38.986	-90.307	-21.475	1.564
3100	17.827	41.655	28.508	40.757	-89.778	-19.189	1.353
3200	18.046	42.224	28.927	42.550	-89.229	-16.918	1.155
3300	18.270	42.783	29.339	44.366	-88.657	-14.668	0.971
3400	18.493	43.332	29.742	46.204	-88.064	-12.434	0.799
3500	18.717	43.871	30.138	48.065	-87.449	-10.218	0.638
3583	18.907	44.412	30.522	49.926	-86.922	-8.396	0.512
3583	18.907	44.412	30.522	49.926	-71.922	-8.396	0.512
3600	18.900	44.474	30.547	50.898	-71.862	-8.093	0.491
3700	18.900	45.012	31.040	56.498	-71.509	-6.126	0.374
3800	18.900	45.439	31.519	61.098	-71.156	-4.570	0.263
3900	18.900	45.855	31.984	65.698	-70.804	-2.827	0.158
4000	18.900	46.260	32.435	70.298	-70.452	-1.084	0.059
4100	18.900	46.657	32.875	74.898	-70.101	0.644	-0.034
4200	18.900	47.040	33.303	79.498	-69.750	2.369	-0.123
4300	18.900	47.417	33.720	84.098	-69.400	4.079	-0.207
4400	18.900	47.786	34.126	88.698	-69.050	5.788	-0.287
4500	18.900	48.144	34.523	93.298	-68.701	7.482	-0.363
4600	18.900	48.496	34.910	97.898	-68.352	9.167	-0.436
4700	18.900	48.840	35.287	102.498	-68.003	10.855	-0.505
4800	18.900	49.177	35.657	107.098	-67.655	12.526	-0.570
4900	18.900	49.507	36.018	111.698	-67.307	14.192	-0.633
4985.4	18.900	49.783	36.372	116.298	-66.964	15.813	-0.684
4985.4	18.900	49.783	36.372	116.298	-200.306	15.813	-0.684
5000	18.900	49.830	36.371	116.298	-200.268	16.240	-0.710
5100	18.900	50.147	36.716	120.898	-200.015	20.571	-0.881
5200	18.900	50.456	37.054	125.498	-199.772	24.896	-1.046
5300	18.900	50.762	37.385	130.098	-199.538	29.213	-1.205
5400	18.900	51.062	37.710	134.698	-199.313	33.527	-1.357
5500	18.900	51.355	38.028	139.298	-199.096	37.834	-1.503
5600	18.900	51.644	38.340	143.898	-198.884	42.145	-1.645
5700	18.900	51.927	38.646	148.498	-198.690	46.445	-1.781
5800	18.900	52.205	38.947	153.098	-198.492	50.740	-1.912
5900	18.900	52.476	39.241	157.698	-198.316	55.047	-2.039
6000	18.900	52.747	39.531	162.298	-198.141	59.333	-2.161

31 December 1963

HLS

HAFNIUM NITRIDE (HfN)**(CONDENSED PHASE)**

gfw = 192.508

$$\Delta H_{f298.15} = -88.24 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^0 = 10.7 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3583^\circ\text{K}$$

$$\Delta H_m = 15.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^0 - H_0^0 = 1.773 \text{ kcal gfw}^{-1}$$

$$C_p^0 = 10.936 + 2.2268 \times 10^{-3} T - 1.5998 \times 10^{-5} T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^\circ\text{K} \leq T \leq 3583^\circ\text{K}$$

$$C_p^0 = 16.0 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$3583^\circ\text{K} \leq T \leq 6000^\circ\text{K}$$

Structure

HfN has an fcc structure [NaCl (B1) type] with variable homogeneity range.

Heat of Formation

Combustion-calorimetry data of Humphrey¹ used.

Heat Capacity and Entropy

Low-temperature data estimated. High-temperature data of Neel et al² recalculated in present work and extrapolated to melting point.

Melting and Vaporization

Heat of fusion estimated.

References

1. Humphrey, G. L., J. Am. Chem. Soc. 75, 2806 (1953).
2. Neel, D. S. et al, WADD TR 60-924 (February 1962).

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid Hf from 0° to 2495°K,
Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985°
to 6000°K, Gaseous O₂, Gaseous HfO

T, °K	C_p	ΔH_f°	ΔG_f°	$\log K_p$
0	0.000	0.000	INFINITE	INFINITE
298.15	7.471	57.736	57.736	-9.002
300	7.479	57.783	57.737	-8.916
400	7.911	59.994	58.035	-5.477
500	8.310	61.803	58.613	-3.441
600	8.671	63.351	59.277	-2.103
700	8.990	64.712	59.956	-1.160
800	9.265	65.931	60.630	-0.463
900	9.495	67.035	61.281	0.072
1000	9.682	68.046	61.908	0.494
1100	9.830	68.976	62.508	0.834
1200	9.943	69.836	63.084	1.113
1300	10.025	70.636	63.634	1.346
1400	10.080	71.381	64.161	1.542
1500	10.114	72.078	64.666	1.709
1600	10.130	72.731	65.150	1.852
1700	10.131	73.345	65.614	1.975
1800	10.122	73.924	66.060	2.083
1900	10.103	74.471	66.488	2.177
2000	10.079	74.988	66.900	2.258
2033	10.070	75.153	67.033	2.283
2100	10.050	75.479	67.297	2.325
2200	10.018	75.946	67.680	2.381
2300	9.983	76.391	68.049	2.430
2400	9.948	76.815	68.406	2.473
2495	9.914	77.200	68.733	2.508
2495	9.914	77.200	68.733	2.508
2500	9.912	77.220	68.750	2.509
2600	9.876	77.608	69.083	2.525
2700	9.840	77.980	69.406	2.539
2800	9.805	78.338	69.719	2.551
2900	9.771	78.681	70.022	2.561
3000	9.739	79.012	70.316	2.570
3100	9.707	79.331	70.602	2.577
3200	9.676	79.638	70.879	2.584
3300	9.647	79.936	71.149	2.589
3400	9.619	80.223	71.412	2.594
3500	9.593	80.502	71.668	2.597
3600	9.567	80.772	71.917	2.600
3700	9.543	81.033	72.160	2.602
3800	9.520	81.287	72.397	2.604
3900	9.498	81.534	72.628	2.605
4000	9.477	81.775	72.853	2.605
4100	9.457	82.008	73.074	2.605
4200	9.437	82.236	73.289	2.604
4300	9.419	82.458	73.500	2.604
4400	9.402	82.674	73.706	2.602
4500	9.386	82.885	73.908	2.601
4600	9.370	83.091	74.105	2.599
4700	9.355	83.293	74.299	2.596
4800	9.341	83.490	74.488	2.594
4900	9.327	83.682	74.674	2.591
4985.40	9.316	83.843	74.829	2.588
4985.40	9.316	83.843	74.829	2.588
5000	9.314	83.870	74.856	2.571
5100	9.302	84.055	75.034	2.453
5200	9.290	84.235	75.209	2.340
5300	9.279	84.412	75.381	2.230
5400	9.268	84.585	75.550	2.124
5500	9.258	84.755	75.716	2.022
5600	9.248	84.922	75.879	1.923
5700	9.239	85.086	76.039	1.826
5800	9.230	85.246	76.196	1.733
5900	9.221	85.404	76.351	1.642
6000	9.213	85.559	76.503	1.554

HAFNIUM MONOXIDE (HfO) (IDEAL MOLECULAR GAS) gfw = 194.50

$$\Delta H_{f0} = 19.360 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15} = 18.996 \text{ kcal gfw}^{-1}$$

Ground-State Configuration = $^3\pi$

$$S_{298.15}^\circ = 57.736 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^\circ - H_0^\circ = 2.108 \text{ kcal gfw}^{-1}$$

State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$^3\pi_2$	2	cm ⁻¹ 4003	cm ⁻¹ 895	cm ⁻¹ ---	cm ⁻¹ ---	cm ⁻¹ 0.3792	cm ⁻¹ ---	cm ⁻¹ ---	cm ⁻¹ ---
$^3\pi_1$	2	2084	895	---	---	0.3792	---	---	---
$^3\pi_0$	2	0	895	---	---	0.3792	---	---	---

Heat of Formation

A preliminary value based on the work of Ackermann and Thorn¹ has been used.

Heat Capacity and Entropy

Have been calculated using above spectroscopic constants.^{2, 3}

References

1. Ackermann, R. J. and R. J. Thorn, In: Progress in Ceramic Science, J. E. Burke, ed., Pergamon Press, New York (1961).
2. Krishnamurty, S. G., Proc. Phys. Soc. (London) **64A**, 852 (1951).
3. Brewer, L. and M. S. Chandrasekharaiah, UCRL-8713 (June 1960).

Reference State for Calculating ΔH_f° , ΔG_f° , and $\log K_p$: Solid Hf from 0° to 2495°K,
Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K,
Solid HfO₂ from 0° to 3173°K, Liquid HfO₂ from 3173° to 6000°K

T, K	C_p	ΔH_f° , Kcal/mole	ΔG_f° , Kcal/mole	ΔH_f° , Kcal/mole	ΔG_f° , Kcal/mole	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.345	-264.095	-264.095	INFINITE
298.15	14.400	14.188	14.188	0.000	-266.060	-252.486	185.068
300	14.447	14.277	14.188	0.027	-266.058	-252.401	183.865
400	16.167	18.700	14.780	1.568	-265.891	-247.873	155.425
500	17.079	22.414	15.945	3.234	-265.658	-243.395	106.383
600	17.673	25.583	17.294	4.974	-265.399	-238.968	87.040
700	18.117	28.342	18.680	6.764	-265.128	-234.586	73.237
800	18.482	30.786	20.043	8.594	-264.854	-230.239	62.895
900	18.799	32.982	21.361	10.459	-264.579	-225.929	54.860
1000	19.088	34.977	22.624	12.353	-264.306	-221.648	48.439
1100	19.358	36.810	23.832	14.276	-264.031	-217.397	43.191
1200	19.615	38.505	24.985	16.224	-263.757	-213.169	38.821
1300	19.863	40.085	26.086	18.198	-263.485	-208.964	35.128
1400	20.105	41.566	27.139	20.197	-263.210	-204.781	31.966
1500	20.341	42.961	28.148	22.219	-262.935	-200.616	29.228
1600	20.574	44.281	29.116	24.265	-262.661	-196.473	26.836
1700	20.804	45.535	30.045	26.334	-262.386	-192.343	24.726
1800	21.032	46.731	30.939	28.426	-262.111	-188.232	22.853
1900	21.258	47.874	31.800	30.540	-261.837	-184.134	21.179
1971	21.422	48.679	32.410	32.098	-261.636	-181.150	20.065
1973	21.400	48.946	32.410	34.598	-259.136	-181.150	20.065
2000	21.000	50.299	32.649	35.300	-258.939	-180.084	19.678
2033	26.000	50.725	32.939	36.158	-258.700	-178.785	19.219
2033	26.000	50.725	32.939	36.158	-260.350	-178.785	19.219
2100	26.000	51.568	33.520	37.900	-259.874	-176.106	18.327
2200	26.000	52.777	34.368	40.500	-259.181	-172.133	17.099
2300	26.000	53.933	35.194	43.100	-258.510	-168.193	15.981
2400	26.000	55.040	35.998	45.700	-257.862	-164.281	14.959
2495	26.000	56.049	36.742	48.170	-257.268	-160.586	14.066
2495	26.000	56.049	36.742	48.170	-262.507	-160.586	14.066
2500	26.000	56.101	36.781	48.300	-262.464	-160.382	14.020
2600	26.000	57.121	37.544	50.900	-261.596	-156.317	13.139
2700	26.000	58.102	38.287	53.500	-260.734	-152.285	12.326
2800	26.000	59.048	39.012	56.100	-259.876	-148.284	11.574
2900	26.000	59.960	39.719	58.700	-259.024	-144.315	10.875
3000	26.000	60.841	40.408	61.300	-258.176	-140.372	10.226
3100	26.000	61.694	41.081	63.900	-257.333	-136.455	9.620
3173	26.000	62.299	41.562	65.798	-256.721	-133.616	9.203
3173	26.000	70.178	41.562	90.798	-231.721	-133.616	9.203
3200	26.000	70.398	41.805	91.500	-231.495	-132.786	9.068
3300	26.000	71.148	42.683	94.100	-230.660	-129.711	8.590
3400	26.000	71.975	43.533	96.700	-229.830	-126.663	8.141
3500	26.000	72.728	44.357	99.300	-229.004	-123.642	7.720
3600	26.000	73.461	45.155	101.900	-228.182	-120.642	7.324
3700	26.000	74.173	45.930	104.500	-227.363	-117.668	6.950
3800	26.000	74.866	46.682	107.100	-226.548	-114.710	6.597
3900	26.000	75.542	47.414	109.700	-225.737	-111.780	6.264
4000	26.000	76.200	48.125	112.300	-224.929	-108.868	5.948
4100	26.000	76.842	48.818	114.900	-224.125	-105.980	5.649
4200	26.000	77.469	49.492	117.500	-223.325	-103.100	5.365
4300	26.000	78.080	50.150	120.100	-222.528	-100.246	5.095
4400	26.000	78.678	50.792	122.700	-221.736	-97.412	4.838
4500	26.000	79.262	51.418	125.300	-220.947	-94.605	4.594
4600	26.000	79.834	52.030	127.900	-220.163	-91.798	4.361
4700	26.000	80.393	52.627	130.500	-219.384	-89.011	4.139
4800	26.000	80.940	53.211	133.100	-218.611	-86.242	3.927
4900	26.000	81.477	53.783	135.700	-217.844	-83.496	3.724
4985.40	26.000	81.926	54.261	137.921	-217.195	-81.156	3.558
4985.40	26.000	81.926	54.261	137.921	-350.491	-81.156	3.558
5000	26.000	82.002	54.342	138.500	-350.394	-80.370	3.513
5100	26.000	82.517	54.889	140.900	-349.738	-77.473	3.213
5200	26.000	83.022	55.425	143.500	-349.102	-69.588	2.925
5300	26.000	83.517	55.951	146.100	-348.487	-64.225	2.648
5400	26.000	84.003	56.466	148.700	-347.896	-58.862	2.382
5500	26.000	84.480	56.971	151.300	-347.330	-53.513	2.126
5600	26.000	84.948	57.466	153.900	-346.795	-48.170	1.880
5700	26.000	85.409	57.952	156.500	-346.293	-42.837	1.642
5800	26.000	85.861	58.430	159.100	-345.831	-37.517	1.414
5900	26.000	86.305	58.898	161.700	-345.413	-32.190	1.192
6000	26.000	86.742	59.359	164.300	-345.047	-26.882	0.979

15 June 1967

HLS

HAFNIUM DIOXIDE (HfO₂)

(CONDENSED PHASE)

gfw = 210.50

$$\Delta H_{f298.15}^{\circ} = -266.060 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 14.188 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_t = 1973^{\circ}\text{K}$$

$$\Delta H_t = 2.5 \text{ kcal gfw}^{-1}$$

$$T_m = 3173^{\circ}\text{K}$$

$$\Delta H_m = 25.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.345 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 17.2346 + 2.1628 \times 10^{-3}T - 0.30930 \times 10^{-6}T^{-2} \quad 298.15^{\circ}\text{K} \leq T \leq 1973^{\circ}\text{K}$$

$$C_p^{\circ} = 26.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1973^{\circ}\text{K} \leq T \leq 3173^{\circ}\text{K}$$

$$C_p^{\circ} = 26.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 3173^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

Monoclinic from low temperature to 1973°K; tetragonal above 1973°K.

Heat of Formation

Heat-of-combustion determination is by Humphrey.¹

Heat Capacity and Entropy

Low-temperature data are from Todd.² High-temperature data of Orr³ have been joined to Todd data to 1973°K. Above 1973°K, data from Pears *et al.*⁴ have been used. Data above melting point have been estimated.

Melting and Vaporization

Transition and melting temperatures are from Curtis *et al.*⁵ Heats of transition have been derived to be consistent with Orr³ and Pears *et al.*⁴ Heat of fusion is estimated.

References

1. Humphrey, G. L., J. Am. Chem. Soc. 75, 2806 (1953).
2. Todd, S. S., J. Am. Chem. Soc. 75, 3035 (1953).
3. Orr, R. L., J. Am. Chem. Soc. 75, 1231 (1953).
4. Pears, C. D. *et al.* ASD TDR 62-765 (January 1963).
5. Curtis, C. E., L. M. Doney, and J. R. Johnson, J. Am. Ceram. Soc. 37, 458 (1954).

HAFNIUM DIOXIDE (HfO₂)

(CONDENSED PHASE)

GFW = 210.50

SUMMARY OF UNCERTAINTY ESTIMATES

T °K	C _p cal./°K gfw	S _T cal./°K gfw	-(F _T - H ₂₉₈)/T cal./°K gfw	H _T - H ₂₉₈ Kcal/gfw	ΔH _T Kcal/gfw	ΔF _T Kcal/gfw	Log K _p
298.15	± 0.250	± 0.100	± 0.100	± 0.000	± 4.000		
500	± 0.250	± 0.229	± 0.128	± 0.050			
500	± 0.500	± 0.229	± 0.128	± 0.050			
1000	± 0.500	± 0.576	± 0.275	± 0.300			
1000	± 1.000	± 0.576	± 0.275	± 0.300			
1973	± 1.000	± 1.255	± 0.610	± 1.273			
1973	± 3.000	± 1.762	± 0.610	± 2.273			
2000	± 3.000	± 1.803	± 0.626	± 2.354			
3000	± 3.000	± 3.019	± 1.235	± 5.354			
3173	± 3.000	± 3.188	± 1.337	± 5.873			
3173	± 3.000	± 4.763	± 1.337	± 10.873			
4000	± 3.000	± 5.458	± 2.120	± 13.354			
5000	± 3.000	± 6.128	± 2.857	± 16.354			
6000	± 3.000	± 6.675	± 3.449	± 19.354			

TABLE 145

HAFNIUM DIOXIDE

IDEAL MOLECULAR GAS

HfO₂

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Hf from 0° to 2495°K, Liquid Hf from 2495° to 4985°K, Gaseous Hf from 4985° to 6000°K, Gaseous O₂, Gaseous HfO₂.

T, °K	ΔG	ΔH K cal/gfw	ΔF K cal/gfw	ΔH_f K cal/gfw	ΔH_f K cal/gfw	ΔF_f K cal/gfw	$\log K_p$
0	0.000	0.000	INFINITE	-2.767	-69.257	-69.257	INFINITE
298.15	11.525	60.475	60.475	0.000	-70.000	-70.226	51.475
300	11.545	60.547	60.475	0.021	-70.004	-70.227	51.158
400	12.478	64.003	60.940	1.225	-70.174	-70.277	38.396
500	13.125	66.861	61.847	2.507	-70.325	-70.286	30.721
600	13.566	69.296	62.891	3.843	-70.470	-70.266	25.593
700	13.870	71.411	63.960	5.216	-70.616	-70.222	21.923
800	14.085	73.278	65.010	6.614	-70.774	-70.153	19.164
900	14.241	74.947	66.023	8.031	-70.947	-70.065	17.013
1000	14.358	76.454	66.992	9.461	-71.138	-69.956	15.288
1100	14.447	77.826	67.916	10.902	-71.345	-69.829	13.873
1200	14.516	79.087	68.795	12.350	-71.571	-69.681	12.690
1300	14.571	80.251	69.632	13.804	-71.819	-69.514	11.686
1400	14.615	81.332	70.429	15.264	-72.083	-69.327	10.822
1500	14.651	82.342	71.190	16.727	-72.367	-69.119	10.070
1600	14.681	83.288	71.917	18.194	-72.672	-68.894	9.410
1700	14.706	84.179	72.613	19.663	-72.997	-68.648	8.825
1800	14.727	85.020	73.279	21.135	-73.342	-68.384	8.303
1900	14.745	85.817	73.918	22.608	-73.709	-68.098	7.833
2000	14.760	86.574	74.532	24.084	-74.095	-67.790	7.407
2033	14.764	86.815	74.729	24.571	-74.227	-67.684	7.276
2033	14.764	86.815	74.729	24.571	-74.227	-67.684	7.276
2100	14.773	87.294	75.123	25.560	-74.614	-67.413	7.015
2200	14.785	87.982	75.692	27.038	-75.083	-66.986	6.654
2300	14.795	88.639	76.240	28.517	-75.533	-66.538	6.322
2400	14.803	89.269	76.770	29.997	-75.955	-66.074	6.017
2495	14.811	89.844	77.257	31.464	-76.344	-65.611	5.747
2495	14.811	89.844	77.257	31.464	-76.344	-65.611	5.747
2500	14.811	89.873	77.282	31.478	-76.326	-65.575	5.732
2600	14.818	90.454	77.778	32.959	-76.737	-65.165	5.452
2700	14.824	91.014	78.258	34.442	-77.172	-64.746	5.192
2800	14.830	91.553	78.723	35.924	-77.632	-64.314	4.949
2900	14.835	92.074	79.174	37.408	-78.117	-63.875	4.723
3000	14.839	92.577	79.613	38.891	-78.625	-63.427	4.511
3100	14.844	93.063	80.039	40.375	-79.155	-62.965	4.312
3200	14.847	93.535	80.453	41.860	-79.705	-62.490	4.125
3300	14.851	93.991	80.857	43.345	-80.275	-62.005	3.949
3400	14.854	94.435	81.250	44.830	-80.864	-61.511	3.782
3500	14.857	94.865	81.632	46.316	-81.472	-61.004	3.624
3600	14.859	95.284	82.006	47.801	-82.099	-60.485	3.475
3700	14.862	95.691	82.370	49.287	-82.745	-59.955	3.333
3800	14.864	96.088	82.726	50.774	-83.409	-59.411	3.199
3900	14.866	96.474	83.074	52.260	-84.091	-58.855	3.070
4000	14.868	96.850	83.413	53.747	-84.792	-58.285	2.948
4100	14.870	97.217	83.746	55.234	-85.503	-57.700	2.832
4200	14.871	97.576	84.071	56.721	-86.225	-57.100	2.720
4300	14.873	97.926	84.389	58.208	-86.957	-56.485	2.613
4400	14.874	98.267	84.700	59.695	-87.700	-55.855	2.511
4500	14.875	98.602	85.006	61.183	-88.453	-55.200	2.413
4600	14.877	98.929	85.305	62.670	-89.215	-54.530	2.319
4700	14.878	99.249	85.598	64.158	-89.992	-53.845	2.228
4800	14.879	99.562	85.886	65.646	-90.784	-53.145	2.141
4900	14.880	99.869	86.168	67.134	-91.591	-52.430	2.057
4985.40	14.881	100.126	86.405	68.622	-92.413	-51.700	1.988
4985.40	14.881	100.126	86.405	68.622	-92.413	-51.700	1.988
5000	14.881	100.169	86.445	68.622	-92.401	-51.685	1.959
5100	14.882	100.464	86.717	70.110	-93.228	-50.945	1.887
5200	14.883	100.753	86.984	71.598	-94.070	-50.190	1.822
5300	14.884	101.036	87.247	73.087	-94.927	-49.420	1.763
5400	14.884	101.315	87.505	74.575	-95.799	-48.635	1.709
5500	14.885	101.588	87.758	76.063	-96.686	-47.835	1.660
5600	14.886	101.856	88.007	77.552	-97.589	-47.020	1.616
5700	14.886	102.120	88.253	79.041	-98.507	-46.190	1.577
5800	14.887	102.378	88.494	80.529	-99.440	-45.345	1.542
5900	14.888	102.633	88.732	82.018	-100.388	-44.485	1.510
6000	14.888	102.883	88.965	83.507	-101.350	-43.610	1.480

15 September 1961

HLS

HAFNIUM DIOXIDE (HfO₂)

(IDEAL MOLECULAR GAS)

gfw = 210.50

$$\Delta H_{f0}^{\circ} = -69.257 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -70.000 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S_{298.15}^{\circ} = 60.475 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.767 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

ω , cm ⁻¹	ω , cm ⁻¹
857.4 (1)	931.1 (1)
242.8 (2)	

Bond lengths and angles:

$$\text{Hf-O distance} = 1.74 \text{ \AA}$$

$$\text{O-Hf-O angle} = 180^{\circ}$$

Moments of inertia:

$$I = 16.085 \times 10^{-39} \text{ gm cm}^2 \sigma = 2$$

$$B_e = 0.174 \text{ cm}^{-1}$$

Heat of Formation

Based primarily on observations of Shchukarev and Semenov¹.

Heat Capacity and Entropy

Estimated structural data was used to calculate properties on polyatomic gas computer program.

Reference

1. Shchukarev, S. A., and G. A. Semenov, Izv. V. U. Z. Khim. i Khim. Tekh. No. 5,845 (1962).

HAFNIUM DIOXIDE (HfO₂)

(IDEAL MOLECULAR GAS)

GFW = 210.50

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-R \ln T - H_{298}^{\circ}/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±1.000	±3.000	±3.000	±0.000	±15.000		
1000	±1.000	±4.210	±3.508	±0.702			
2000	±1.000	±4.903	±4.052	±1.702			
3000	±1.000	±5.309	±4.408	±2.702			
4000	±1.000	±5.596	±4.671	±3.702			
5000	±1.000	±5.820	±4.879	±4.702			
6000	±1.000	±6.002	±5.052	±5.702			

TABLE 146

IRIDIUM

REFERENCE STATE

Ir

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ir from 0° to 2700°K,
Liquid Ir from 2700° to 4712°K, Gaseous Ir from 4712° to 6000°K

T, °K	$\log p$	S_f	$(-F_f^\circ - H_{298}^\circ)/T$	$(H_f^\circ - H_{298}^\circ)$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE				
298.15	6.110	8.497	8.497	-1.274			
300	6.117	8.535	8.498	0.000			
400	6.393	10.335	8.740	0.011			
500	6.598	11.764	9.208	0.638			
				1.288			
600	6.774	13.003	9.744	1.956			
700	6.936	14.060	10.286	2.642			
800	7.091	14.996	10.817	3.343			
900	7.243	15.840	11.329	4.060			
1000	7.391	16.611	11.819	4.792			
1100	7.538	17.322	12.287	5.539			
1200	7.685	17.985	12.715	6.300			
1300	7.830	18.605	13.162	7.075			
1400	7.974	19.191	13.572	7.866			
1500	8.118	19.746	13.966	8.670			
1600	8.262	20.275	14.344	9.489			
1700	8.406	20.780	14.708	10.323			
1800	8.549	21.264	15.058	11.170			
1900	8.692	21.710	15.397	12.032			
2000	8.835	22.180	15.725	12.909			
2100	8.978	22.614	16.043	13.799			
2200	9.121	23.015	16.351	14.704			
2300	9.263	23.444	16.641	15.623			
2400	9.406	23.841	16.942	16.557			
2500	9.549	24.228	17.226	17.505			
2600	9.691	24.605	17.502	18.467			
2700	9.833	24.973	17.772	19.442			
2700	10.000	25.273	17.772	20.432			
2800	10.000	25.637	18.118	21.437			
2900	10.000	25.988	18.453	22.457			
3000	10.000	26.328	18.777	23.492			
3100	10.000	26.655	19.090	24.542			
3200	10.000	26.972	19.393	25.607			
3300	10.000	27.280	19.688	26.687			
3400	10.000	27.578	19.974	27.782			
3500	10.000	27.868	20.253	28.892			
3600	10.000	30.150	20.524	30.017			
3700	10.000	30.424	20.788	31.157			
3800	10.000	30.691	21.046	32.312			
3900	10.000	30.950	21.296	33.482			
4000	10.000	31.204	21.541	34.667			
4100	10.000	31.455	21.779	35.867			
4200	10.000	31.692	22.013	37.082			
4300	10.000	31.927	22.240	38.312			
4400	10.000	32.157	22.464	39.557			
4500	10.000	32.381	22.681	40.817			
4600	10.000	32.601	22.894	42.092			
4700	10.000	32.816	23.103	43.382			
4711.55	10.000	32.844	23.135	43.748			
4711.55	7.556	62.974	23.135	147.143			
4800	7.567	63.222	23.863	148.397			
4900	7.579	63.728	24.665	149.154			
5000	7.592	64.471	25.438	149.913			
5100	7.605	65.572	26.185	150.672			
5200	7.618	66.719	26.905	151.434			
5300	7.632	67.865	27.602	152.196			
5400	7.646	69.007	28.274	152.960			
5500	7.661	70.148	28.925	153.725			
5600	7.676	71.286	29.555	154.492			
5700	7.692	72.422	30.166	155.261			
5800	7.708	73.556	30.758	156.031			
5900	7.726	74.688	31.332	156.802			
6000	7.744	75.818	31.889	157.576			

15 September 1967

RCF

IRIDIUM (Ir)

(REFERENCE STATE)

gfw = 192.2

0°K to 2700°K
 2700°K to 4711.55°K
 4711.55°K to 6000°K

Crystal
 Liquid
 Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 158.000 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 8.497 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2700^{\circ}\text{K}$$

$$\Delta H_m = 6.210 \text{ kcal gfw}^{-1}$$

$$T_b = 4711.55^{\circ}\text{K}$$

$$\Delta H_v = 141.960 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.274 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.997 + 1.422 \times 10^{-3}T + 0.2763 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 2700^{\circ}\text{K}$$

$$C_p^{\circ} = 10.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2700^{\circ}\text{K} \leq T \leq 4711.55^{\circ}\text{K}$$

Structure

An fcc (Al) type ¹

Heat of Formation

Zero by definition

Heat Capacity and Entropy

See volume 1, this study (section IVA10) for details.

Melting

An average of three determinations adopted.

Vaporization

An extrapolation of ΔF_f° of the ideal gas to zero adopted

Reference

1. Owens, E. A. and E. L. Yates, Phil Mag 15, 472 (1933)

IRIDIUM (Ir)

(REFERENCE STATE)

GFW = 192.2

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$(F_T - H_{298})/T$	$(H_T - H_{298})$	ΔH_f	ΔF_f	Log K _p
298.15	±0.070	±0.040	±0.040	±0.000			
1000	±0.500	±0.390	±0.190	±0.200			
2000	±1.000	±0.900	±0.420	±0.950			
2700	±1.500	±1.270	±0.590	±1.810			
2700	±1.500	±1.640	±0.590	±2.810			
3000	±1.130	±1.730	±0.710	±3.070			
4000	±3.130	±2.340	±1.040	±5.200			
4711.55	±4.560	±2.970	±1.280	±7.940			
4711.55	±0.002	±0.003	±0.003	±0.003			
5000	±0.002	±0.003	±0.003	±0.003			
6000	±0.004	±0.004	±0.003	±0.006			

TABLE 147

IRIDIUM

IDI AL. MONATOMIC GAS

Ir

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ir from 0° to 2700°K,
Liquid Ir from 2700° to 4712°K, Gaseous Ir from 4712° to 6000°K

T, °K	C_p	S_T	$(F_T - H_{298}^\circ)/T$	$(H_T - H_{298}^\circ)/T$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	157.793	157.793	INFINITE
298.15	4.969	45.242	46.242	0.000	158.000	146.746	-107.563
300	4.969	46.273	46.242	0.009	157.998	146.677	-106.849
400	4.976	47.703	46.437	0.506	157.868	142.921	-78.085
500	5.007	48.816	46.806	1.005	157.717	139.201	-60.842
600	5.075	49.734	47.219	1.509	157.553	135.514	-49.359
700	5.180	50.524	47.636	2.021	157.379	131.855	-41.165
800	5.314	51.244	48.047	2.546	157.203	128.220	-35.076
900	5.465	51.899	48.431	3.085	157.025	124.608	-30.258
1000	5.622	52.443	48.804	3.639	156.847	121.015	-26.447
1100	5.780	52.986	49.159	4.209	156.670	117.441	-23.332
1200	5.933	53.495	49.500	4.795	156.495	113.882	-20.740
1300	6.079	53.976	49.826	5.396	156.321	110.337	-18.548
1400	6.215	54.432	50.139	6.010	156.144	106.806	-16.672
1500	6.340	54.865	50.439	6.638	155.968	103.291	-15.049
1600	6.455	55.278	50.727	7.278	155.789	99.784	-13.629
1700	6.560	55.672	51.008	7.929	155.606	96.290	-12.378
1800	6.654	56.050	51.278	8.590	155.420	92.804	-11.267
1900	6.739	56.412	51.539	9.259	155.237	89.330	-10.275
2000	6.815	56.760	51.791	9.937	155.058	85.868	-9.383
2100	6.883	57.094	52.036	10.622	154.873	82.415	-8.577
2200	6.944	57.415	52.273	11.314	154.680	78.972	-7.845
2300	6.999	57.725	52.503	12.011	154.488	75.540	-7.178
2400	7.048	58.024	52.727	12.713	154.296	72.116	-6.567
2500	7.093	58.313	52.945	13.420	154.105	68.703	-6.006
2600	7.133	58.592	53.157	14.132	153.915	65.297	-5.489
2700	7.170	58.862	53.363	14.847	153.725	61.904	-5.011
2700	7.170	58.862	53.363	14.847	147.195	61.904	-5.011
2800	7.204	59.123	53.564	15.566	146.914	58.751	-4.585
2900	7.235	59.377	53.760	16.288	146.636	55.610	-4.191
3000	7.263	59.622	53.952	17.012	146.360	52.475	-3.823
3100	7.289	59.861	54.138	17.740	146.088	49.351	-3.479
3200	7.313	60.093	54.321	18.470	145.818	46.240	-3.157
3300	7.336	60.318	54.499	19.203	145.551	43.124	-2.856
3400	7.357	60.537	54.674	19.937	145.284	40.020	-2.572
3500	7.377	60.751	54.844	20.674	145.022	36.942	-2.306
3600	7.396	60.959	55.011	21.413	144.761	33.847	-2.055
3700	7.413	61.162	55.175	22.153	144.501	30.768	-1.817
3800	7.430	61.360	55.335	22.895	144.247	27.732	-1.593
3900	7.446	61.554	55.492	23.637	143.987	24.636	-1.380
4000	7.461	61.747	55.646	24.385	143.733	21.580	-1.179
4100	7.475	61.928	55.797	25.134	143.479	18.526	-0.987
4200	7.489	62.107	55.945	25.880	143.228	15.486	-0.806
4300	7.503	62.283	56.090	26.629	142.977	12.445	-0.632
4400	7.516	62.456	56.233	27.380	142.728	9.416	-0.468
4500	7.529	62.625	56.373	28.132	142.480	6.386	-0.310
4600	7.541	62.790	56.511	28.886	142.234	3.362	-0.160
4700	7.554	62.953	56.646	29.641	141.989	0.348	-0.016
4711.55	7.556	62.971	56.661	29.728	141.960	0.000	0.000
4711.55	7.556	62.971	56.661	29.728			
4800	7.567	63.112	56.779	30.397			
4900	7.579	63.268	56.910	31.04			
5000	7.592	63.421	57.039	31.673			
5100	7.605	63.572	57.165	32.302			
5200	7.618	63.719	57.290	32.934			
5300	7.632	63.865	57.413	33.566			
5400	7.646	64.007	57.533	34.196			
5500	7.661	64.148	57.652	34.825			
5600	7.676	64.286	57.770	35.452			
5700	7.692	64.422	57.885	36.076			
5800	7.708	64.556	57.999	36.697			
5900	7.726	64.688	58.111	37.312			
6000	7.744	64.818	58.222	37.926			

15 September 1962

RCF

IRIDIUM (Ir)

(IDEAL MONATOMIC GAS)

gfw = 192.2

$$\Delta H_{f0}^{\circ} = 157.793 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 158.000 \text{ kcal gfw}^{-1}$$

Ground State Configuration = $4f_{14} 5d^7$

$$S_{298.15}^{\circ} = 4.969 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and MultiplicitiesEnergy levels from Moore.¹Heat of FormationThird-Law determination of the Panish and Reif data.²Heat Capacity and Entropy

Obtained from the monatomic gas-computer program.

References

1. Moore, C., Nat. Bur. Stds. (U. S.), Circ. 467, Vol. 3 (1 May 1958).
2. Panish, M. B. and L. Reif, J. Chem. Phys. 34, 1915 (1961).

IRIDIUM, MONATOMIC (Ir)

(IDEAL GAS)

GFW = 192.2

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$(H_T^{\circ} - H_{298}^{\circ})/T$	$(H_T^{\circ} - H_{298}^{\circ})$	ΔH_f°	ΔG_f°	$\log K_p$
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 1.000	± 1.010	± 0.740
1000	± 0.000	± 0.002	± 0.003	± 0.000	± 1.200	± 1.190	± 0.260
2000	± 0.001	± 0.003	± 0.003	± 0.001	± 1.950	± 1.850	± 0.200
2700	± 0.001	± 0.003	± 0.003	± 0.001	± 2.810	± 2.600	± 0.210
2700	± 0.001	± 0.003	± 0.003	± 0.001	± 3.810	± 2.600	± 0.210
3000	± 0.001	± 0.003	± 0.003	± 0.001	± 4.070	± 3.140	± 0.230
4000	± 0.001	± 0.003	± 0.003	± 0.002	± 6.200	± 5.170	± 0.280
4711.55	± 0.002	± 0.003	± 0.003	± 0.003	± 8.940	± 7.050	± 0.330
4711.55	± 0.002	± 0.003	± 0.003	± 0.003			
5000	± 0.002	± 0.003	± 0.003	± 0.003			
6000	± 0.004	± 0.004	± 0.003	± 0.006			

TABLE 148

IRIDIUM MONOXIDE

IDEAL MOLECULAR GAS

IrO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ir from 0° to 2700 °K,
 Liquid Ir from 2700° to 4712°K, Gaseous Ir from 4712° to 6000°K, Gaseous O₂, Gaseous IrO.

T, °K	c_p cal/°K g-atom	s_T° cal/°K g-atom	$-(F_T^\circ - H_{298}^\circ)/T$ cal/°K g-atom	$H_T^\circ - H_{298}^\circ$ Kcal/g-atom	ΔH_f° Kcal/g-atom	ΔF_f° Kcal/g-atom	$\log K_p$
0	0.000	0.000	INFINITE	-2.124	106.394	106.394	INFINITE
298.15	7.623	59.634	59.634	0.000	106.000	98.059	-71.876
300	7.631	59.681	59.634	0.014	105.996	98.010	-71.397
400	8.011	61.931	59.938	0.797	105.798	95.378	-52.110
500	8.270	63.749	60.524	1.612	105.597	92.796	-40.559
600	8.442	65.272	61.192	2.448	105.387	90.256	-32.874
700	8.558	66.583	61.871	3.299	105.164	87.750	-27.396
800	8.640	67.731	62.533	4.159	104.924	85.280	-23.296
900	8.698	68.753	63.168	5.026	104.667	82.840	-20.115
1000	8.742	69.671	63.774	5.898	104.392	80.429	-17.577
1100	8.775	70.506	64.348	6.774	104.103	78.046	-15.506
1200	8.801	71.271	64.894	7.653	103.797	75.691	-13.785
1300	8.821	71.976	65.412	8.534	103.474	73.362	-12.333
1400	8.837	72.630	65.904	9.417	103.134	71.059	-11.092
1500	8.850	73.241	66.373	10.301	102.779	68.780	-10.021
1600	8.861	73.812	66.821	11.187	102.407	66.524	-9.086
1700	8.870	74.350	67.248	12.073	102.019	64.292	-8.265
1800	8.878	74.857	67.657	12.960	101.61	62.084	-7.538
1900	8.884	75.337	68.048	13.849	101.193	59.901	-6.890
2000	8.890	75.793	68.424	14.738	100.756	57.740	-6.309
2100	8.895	76.227	68.785	15.627	100.302	55.601	-5.786
2200	8.899	76.641	69.133	16.516	99.831	53.483	-5.313
2300	8.903	77.036	69.468	17.407	99.344	51.388	-4.883
2400	8.906	77.415	69.792	18.297	98.840	49.311	-4.490
2500	8.909	77.779	70.104	19.188	98.320	47.259	-4.131
2600	8.911	78.128	70.406	20.079	97.782	45.226	-3.801
2700	8.914	78.465	70.698	20.970	97.229	43.216	-3.498
2800	8.916	78.789	70.981	21.861	96.663	41.232	-3.236
2900	8.917	79.102	71.256	22.753	96.085	39.276	-2.993
3000	8.919	79.404	71.523	23.645	95.497	37.347	-2.768
3100	8.921	79.697	71.782	24.537	94.898	35.446	-2.559
3200	8.922	79.980	72.033	25.429	94.289	33.571	-2.364
3300	8.923	80.254	72.278	26.321	93.670	31.721	-2.183
3400	8.924	80.521	72.517	27.214	93.041	29.896	-2.013
3500	8.925	80.780	72.749	28.106	92.402	28.098	-1.854
3600	8.926	81.031	72.976	28.999	91.754	26.326	-1.704
3700	8.927	81.276	73.197	29.891	91.097	24.580	-1.564
3800	8.928	81.514	73.413	30.784	90.431	22.850	-1.432
3900	8.929	81.746	73.623	31.677	89.756	21.136	-1.308
4000	8.929	81.972	73.829	32.570	89.071	19.448	-1.191
4100	8.930	82.192	74.030	33.463	88.377	17.786	-1.081
4200	8.931	82.407	74.227	34.356	87.674	16.150	-0.976
4300	8.931	82.618	74.420	35.249	86.961	14.539	-0.877
4400	8.932	82.823	74.609	36.142	86.239	12.953	-0.783
4500	8.932	83.024	74.794	37.035	85.508	11.392	-0.694
4600	8.933	83.220	74.975	37.929	84.768	9.856	-0.610
4700	8.933	83.412	75.152	38.822	84.019	8.344	-0.530
4711.55	8.933	83.435	75.173	38.929	83.974	8.232	-0.521
4711.55	8.933	83.435	75.173	38.929	-62.986	11.232	-0.521
4800	8.933	83.600	75.326	39.715	-63.321	12.628	-0.575
4900	8.934	83.784	75.497	40.609	-63.700	14.111	-0.634
5000	8.934	83.965	75.664	41.502	-64.087	15.675	-0.691
5100	8.934	84.142	75.829	42.395	-64.478	17.308	-0.746
5200	8.935	84.315	75.990	43.289	-64.876	19.020	-0.799
5300	8.935	84.485	76.149	44.182	-65.282	20.801	-0.851
5400	8.935	84.652	76.305	45.076	-65.696	22.662	-0.901
5500	8.936	84.816	76.458	45.969	-66.120	23.899	-0.950
5600	8.936	84.977	76.609	46.863	-66.556	25.436	-0.997
5700	8.936	85.136	76.757	47.757	-67.008	27.192	-1.043
5800	8.936	85.290	76.903	48.650	-67.477	28.851	-1.087
5900	8.937	85.444	77.046	49.544	-67.964	30.521	-1.131
6000	8.937	85.594	77.188	50.437	-68.478	32.194	-1.173

15 September 1962

RCF

$$\Delta H_{f0}^{\circ} = 106.394 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 106.000 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 4

$$S_{298.15}^{\circ} = 59.634 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.124 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	R_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	4	0.0	790	---	---	0.335	---	---	---

Heat of Formation

Data of Schafer and Heitland adopted in compilation. ¹

Heat Capacity and Entropy

Determined from using spectroscopic constants. See volume 1, this study (section IVA10.4) for details.

Reference

1. Schafer, H. and H. J. Heitland, Z. Anorg. Allgem. Chem. 304, 249 (1960).

TABLE 149

MAGNESIUM

REFERENCE STATE

Mg

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mg from 0° to 923°K,
Liquid Mg from 923° to 1377°K, Gaseous Mg from 1377° to 6000°K.

T, °K	G_f°	H_f° (cal/k gfw)	H_{298}°/T	$H_f^\circ - H_{298}^\circ$ (Kcal/k gfw)	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.195			
298.15	5.951	7.800	7.800	0.000			
300	5.957	7.816	7.800	0.011			
400	6.212	9.587	8.037	0.670			
500	6.490	11.001	8.492	1.254			
600	6.808	12.212	9.013	1.919			
700	7.137	13.286	9.548	2.616			
800	7.470	14.261	10.077	3.347			
900	7.807	15.160	10.593	4.110			
923	7.885	15.358	10.709	4.291			
923	7.800	17.662	10.709	6.418			
1000	7.800	18.287	11.268	7.019			
1100	7.800	19.030	11.940	7.799			
1200	7.800	19.704	12.560	8.579			
1300	7.800	20.333	13.134	9.359			
1376.37	7.800	20.778	13.545	9.960			
1376.47	4.968	44.142	13.545	40.700			
1400	4.968	43.188	14.035	40.814			
1500	4.968	44.531	15.990	41.311			
1600	4.968	45.851	17.721	41.808			
1700	4.968	46.153	19.268	42.305			
1800	4.968	46.437	20.655	42.801			
1900	4.968	46.705	21.917	43.298			
2000	4.969	46.960	23.062	43.795			
2100	4.969	47.202	24.111	44.292			
2200	4.970	47.434	25.075	44.789			
2300	4.972	47.655	25.965	45.286			
2400	4.974	47.866	26.790	45.783			
2500	4.978	48.069	27.557	46.281			
2600	4.983	48.265	28.273	46.779			
2700	4.989	48.453	28.943	47.278			
2800	4.998	48.634	29.571	47.777			
2900	5.009	48.810	30.163	48.277			
3000	5.023	48.980	30.720	48.779			
3100	5.040	47.145	31.248	49.282			
3200	5.060	47.305	31.747	49.787			
3300	5.085	47.461	32.220	50.294			
3400	5.114	47.614	32.672	50.804			
3500	5.148	47.762	33.100	51.317			
3600	5.187	47.908	33.510	51.834			
3700	5.229	48.051	33.901	52.354			
3800	5.278	48.191	34.275	52.880			
3900	5.332	48.328	34.634	53.410			
4000	5.392	48.464	34.978	53.946			
4100	5.457	48.598	35.308	54.489			
4200	5.528	48.730	35.626	55.038			
4300	5.604	48.861	35.933	55.594			
4400	5.686	48.991	36.228	56.159			
4500	5.773	49.120	36.513	56.732			
4600	5.866	49.248	36.788	57.314			
4700	5.964	49.374	37.055	57.905			
4800	6.067	49.502	37.313	58.507			
4900	6.176	49.628	37.563	59.119			
5000	6.289	49.754	37.806	59.742			
5100	6.407	49.879	38.040	60.377			
5200	6.530	50.005	38.270	61.024			
5300	6.658	50.131	38.493	61.683			
5400	6.790	50.256	38.709	62.355			
5500	6.927	50.382	38.920	63.041			
5600	7.069	50.508	39.126	63.741			
5700	7.215	50.635	39.327	64.455			
5800	7.366	50.761	39.522	65.184			
5900	7.522	50.889	39.715	65.929			
6000	7.682	51.016	39.901	66.689			

15 September 1962

RCF

MAGNESIUM (Mg)

(REFERENCE STATE)

gfw = 24.32

0°K to 923°K

923°K to 1376.37°K

1376.37°K to 6000°K

Crystal

Liquid

Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{298.15}^{\circ} = 35.340 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 7.800 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 923^{\circ}\text{K}$$

$$\Delta H_m = 2.127 \text{ kcal gfw}^{-1}$$

$$T_b = 1376.37^{\circ}\text{K}$$

$$\Delta H_v = 30.740 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.195 \text{ kcal gfw}^{-1}$$

StructureSee Barriault *et al*¹ for further details.Heat of Formation

Zero by definition.

Heat Capacity and EntropySee Barriault *et al*¹ for further details.MeltingSee Barriault *et al*¹ for further details.VaporizationSee Barriault *et al*¹ for further details.Reference

1. Barriault, R. J. *et al*, Thermodynamics of Certain Refractory Compounds, Vol. 1, ASD TR 61-260, Pt. I (May 1962).

MAGNESIUM (Mg)

(REFERENCE STATE)

GFW = 24.32

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	± 0.030	± 0.030	± 0.030	± 0.000			
923	± 0.060	± 0.060	± 0.020	± 0.040			
923	± 0.160	± 0.090	± 0.020	± 0.070			
1376.37	± 0.600	± 0.210	± 0.070	± 0.200			
1376.37	± 0.000	± 0.002					
2000	± 0.000	± 0.002					
3000	± 0.001	± 0.002					
4000	± 0.002	± 0.003					
5000	± 0.002	± 0.003					
6000	± 0.002	± 0.003					

TABLE 150

MAGNESIUM

IDEAL MONATOMIC GAS

Mg

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mg from 0° to 923°K,
Liquid Mg from 923° to 1377°K, Gaseous Mg from 1377° to 6000°K.

T, °K	$\left(\frac{1}{T} - \frac{1}{T_0} \right) \int_{T_0}^T \frac{C_p}{T^2} dT$	$\left(\frac{1}{T} - \frac{1}{T_0} \right) \int_{T_0}^T \frac{C_p}{T^2} dT$	$\left(\frac{1}{T} - \frac{1}{T_0} \right) \int_{T_0}^T \frac{C_p}{T^2} dT$	$\left(\frac{1}{T} - \frac{1}{T_0} \right) \int_{T_0}^T \frac{C_p}{T^2} dT$	$\left(\frac{1}{T} - \frac{1}{T_0} \right) \int_{T_0}^T \frac{C_p}{T^2} dT$	$\left(\frac{1}{T} - \frac{1}{T_0} \right) \int_{T_0}^T \frac{C_p}{T^2} dT$	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	35.054	35.054	INFINITE
298.15	4.968	35.504	35.504	0.000	35.340	27.080	-19.849
300	4.968	35.535	35.504	0.009	35.338	27.029	-19.690
400	4.968	36.964	35.699	0.506	35.226	24.775	-13.263
500	4.968	38.073	36.067	1.003	35.089	21.553	-9.420
600	4.968	38.978	36.479	1.500	34.921	18.860	-6.869
700	4.968	39.744	36.892	1.996	34.720	16.199	-5.057
800	4.968	40.408	37.291	2.493	34.486	13.569	-3.707
900	4.968	40.993	37.671	2.990	34.220	10.970	-2.664
923	4.968	41.118	37.755	3.104	34.153	10.377	-2.457
923	4.968	41.118	37.755	3.104	32.026	10.377	-2.457
1000	4.968	41.516	38.029	3.487	31.808	8.580	-1.875
1100	4.968	41.990	38.368	3.984	31.525	6.269	-1.245
1200	4.968	42.422	38.688	4.481	31.242	3.986	-0.726
1300	4.968	42.820	38.991	4.977	30.958	1.726	-0.290
1376.37	4.968	43.102	39.210	5.360	30.740	0.000	0.000
1376.37	4.968	43.102	39.210	5.360			
1400	4.968	43.188	39.278	5.474			
1500	4.968	43.531	39.550	5.971			
1600	4.968	43.851	39.809	6.468			
1700	4.968	44.153	40.056	6.965			
1800	4.968	44.437	40.291	7.461			
1900	4.968	44.705	40.517	7.958			
2000	4.968	44.960	40.732	8.455			
2100	4.969	45.202	40.940	8.952			
2200	4.970	45.434	41.139	9.449			
2300	4.972	45.655	41.330	9.946			
2400	4.974	45.866	41.515	10.443			
2500	4.978	46.069	41.693	10.941			
2600	4.983	46.265	41.865	11.439			
2700	4.988	46.453	42.032	11.938			
2800	4.994	46.634	42.193	12.437			
2900	5.000	46.810	42.349	12.937			
3000	5.007	46.980	42.500	13.439			
3100	5.014	47.145	42.648	13.942			
3200	5.021	47.305	42.791	14.447			
3300	5.028	47.461	42.930	14.954			
3400	5.034	47.614	43.065	15.464			
3500	5.041	47.762	43.197	15.977			
3600	5.048	47.908	43.326	16.494			
3700	5.055	48.051	43.452	17.014			
3800	5.062	48.191	43.575	17.540			
3900	5.069	48.328	43.695	18.070			
4000	5.076	48.464	43.813	18.606			
4100	5.083	48.598	43.928	19.149			
4200	5.090	48.730	44.040	19.698			
4300	5.097	48.861	44.151	20.254			
4400	5.104	48.991	44.260	20.819			
4500	5.111	49.120	44.366	21.392			
4600	5.118	49.248	44.471	21.974			
4700	5.125	49.375	44.574	22.565			
4800	5.132	49.502	44.675	23.167			
4900	5.139	49.628	44.775	23.779			
5000	5.146	49.754	44.873	24.402			
5100	5.153	49.879	44.970	25.037			
5200	5.160	50.005	45.066	25.684			
5300	5.167	50.131	45.160	26.343			
5400	5.174	50.256	45.253	27.015			
5500	5.181	50.382	45.346	27.701			
5600	5.188	50.508	45.437	28.401			
5700	5.195	50.635	45.527	29.115			
5800	5.202	50.761	45.616	29.844			
5900	5.209	50.889	45.704	30.589			
6000	5.216	51.016	45.792	31.349			

15 September 1962

RCF

MAGNESIUM (Mg)

(IDEAL MONATOMIC GAS)

gfw = 24.32

$$\Delta H_{f0}^{\circ} = 30.054 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 35.340 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^1S_0$$

$$S_{298.15}^{\circ} = 35.504 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Energy levels from Moore. ¹

Heat of Formation

See Barriault et al. ²

Heat Capacity and Entropy

See Barriault et al. ²

References

1. Moore, C., NBS Circ. 467, Vol. 1 (15 June 1949).
2. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds, ASD TR 61-260, Pt. I (May 1962).

MAGNESIUM, MONATOMIC (Mg)

(IDEAL GAS)

GFW = 24.32

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal / °K gfw			Kcal gfw			log K _f
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.000	± 0.002	± 0.000	± 0.000	± 0.250	± 0.260	± 0.190
923					± .290	± 0.270	± 0.060
923					± .320	± 0.270	± 0.060
1000	± 0.000	± 0.002	± 0.002	± 0.000			
1376.37					± .450	± 0.350	± 0.060
2000	± 0.000	± 0.002	± 0.003	± 0.001			
3000	± 0.001	± 0.002	± 0.003	± 0.001			
4000	± 0.002	± 0.003	± 0.003	± 0.002			
5000	± 0.002	± 0.003	± 0.003	± 0.004			
6000	± 0.002	± 0.003	± 0.003	± 0.005			

TABLE 151

MAGNESIUM OXIDE

CONDENSED PHASE

MgO

Reference State for Calculating ΔH_f° , ΔF_f° and Log K_p : Solid Mg from 0° to 923°K,
 Liquid Mg from 923° to 1377°K, Gaseous Mg from 1377° to 4000°K,
 Gaseous O₂, Solid MgO from 0° to 3098°K, Liquid MgO from 3098° to 4000°K.

T, °K	C_p	S_T	$-(F_f)_{H_{2O}}/T$	H_f	H_{2O}	ΔH_f	ΔF_f	Log K_p
0	0.000	0.000	INFINITE	-1.235	-142.703	-142.703	INFINITE	
298.15	8.906	6.449	6.439	0.000	-143.700	-135.988	99.677	
300	8.939	6.455	6.440	0.017	-143.701	-135.994	99.678	
400	10.148	9.252	6.807	0.978	-143.704	-133.351	72.856	
500	10.854	11.599	7.538	2.031	-143.650	-130.770	57.157	
600	11.323	13.622	8.387	3.141	-143.583	-128.199	46.694	
700	11.656	15.394	9.263	4.291	-143.512	-125.640	39.225	
800	11.905	16.967	10.130	5.469	-143.471	-123.090	33.625	
900	12.098	18.381	10.970	6.670	-143.440	-120.544	29.271	
923	12.135	18.683	11.154	6.949	-143.436	-119.955	28.402	
923	12.135	18.683	11.154	6.949	-143.436	-119.955	28.402	
1000	12.251	19.663	11.775	7.888	-143.545	-117.824	25.749	
1100	12.475	20.817	12.547	9.119	-143.513	-115.054	22.858	
1200	12.678	21.918	13.283	10.362	-143.474	-112.286	20.449	
1300	12.865	22.921	14.087	11.614	-143.431	-109.524	18.412	
1376.37	12.622	23.644	14.565	12.584	-143.394	-107.401	17.045	
1376.37	12.622	23.644	14.565	12.584	-143.394	-107.401	17.045	
1400	12.638	23.854	14.659	12.874	-143.058	-106.251	16.586	
1500	12.701	24.729	15.301	14.141	-143.72	-101.276	14.755	
1600	12.756	25.550	15.916	15.414	-143.384	-96.325	13.157	
1700	12.804	26.325	16.506	16.692	-143.046	-91.393	11.749	
1800	12.845	27.058	17.072	17.975	-142.707	-86.481	10.500	
1900	12.882	27.754	17.616	19.261	-142.361	-81.590	9.385	
2000	12.915	28.415	18.139	20.551	-142.018	-76.716	8.383	
2100	12.945	29.046	18.644	21.844	-141.675	-71.860	7.478	
2200	12.971	29.644	19.131	23.140	-141.332	-67.020	6.658	
2300	12.994	30.216	19.601	24.448	-140.989	-62.194	5.910	
2400	13.016	30.760	20.055	25.735	-140.646	-57.385	5.225	
2500	13.035	31.281	20.494	27.042	-140.302	-52.589	4.597	
2600	13.052	31.783	20.921	28.346	-140.965	-47.808	4.018	
2700	13.068	32.266	21.334	29.652	-140.627	-43.040	3.484	
2800	13.082	32.731	21.734	30.959	-140.290	-38.284	2.988	
2900	13.095	33.181	22.124	32.268	-139.955	-33.539	2.527	
3000	13.107	33.615	22.500	33.575	-139.623	-28.807	2.099	
3098	13.118	34.116	22.853	34.883	-139.290	-24.178	1.706	
3098	13.118	34.116	22.853	34.883	-139.290	-24.178	1.706	
3100	13.118	34.116	22.853	34.883	-139.290	-24.178	1.706	
3200	13.127	34.597	23.246	36.192	-138.957	-19.948	1.365	
3300	13.135	35.061	23.620	37.502	-138.624	-15.891	1.052	
3400	13.142	35.510	23.984	38.812	-138.291	-11.802	0.759	
3500	13.148	35.945	24.339	40.122	-137.958	-7.737	0.483	
3600	13.153	36.367	24.685	41.432	-137.625	-3.676	0.223	
3700	13.158	36.777	25.022	42.742	-137.292	0.367	-0.022	
3800	13.162	37.175	25.350	44.052	-136.959	4.399	-0.253	
3900	13.166	37.562	25.669	45.362	-136.626	8.418	-0.472	
4000	13.169	37.938	25.978	46.672	-136.293	12.428	-0.679	

15 December 1962

RCF

$$\Delta H_{f298.15}^{\circ} = -143.700 \text{ kcal gfw}^{-1} \quad S_{298.15}^{\circ} = 6.439 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3098^{\circ}\text{K}$$

$$\Delta H_m = 18.5 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.235 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 13.7146 - 4.494 \times 10^{-5}T - 1418T^{-1} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3098^{\circ}\text{K}$$

$$C_p^{\circ} = 14.6 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$3098^{\circ}\text{K} \leq T \leq 4000^{\circ}\text{K}$$

Structure

An fcc (NaCl) type.

Heat of Formation

Based on data of Holley and Huber.¹

Heat Capacity and Entropy

Several sources available. Analysis by the Nat. Bur. Stds. (U.S.)² used for low-and high-temperature data. The latter extrapolated to melting point from 1200°K. Liquid C_p estimated. Heat of fusion estimated.

References

1. Holley, C. E. and E. J. Huber, J. Am. Chem. Soc. 73, 5577 (1951).
2. Nat. Bur. Stds. (U.S.) Rept. 6484 (1959).

MAGNESIUM OXIDE (MgO)

(CONDENSED PHASE)

GFW = 40.32

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal gfw			Log K _p
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	±0.050	±0.020	±0.020	±0.000	±0.500	±0.510	0.370
921					±.610	±0.580	0.140
923					±.640	±0.580	0.140
1000	±0.280	±0.160	±0.080	±0.080			
1376.37					±.900	±0.760	0.120
1376.37					±1.350	±0.760	0.120
2000	±0.940	±0.390	±0.180	±0.410	±1.560	±1.000	0.110
3098	±1.780	±0.570	±0.290	±0.860	±2.010	±1.620	0.110
3098	±1.000	±1.050	±0.290	±2.360	±3.510	±1.620	0.110
4000	±2.000	±1.440	±0.500	±3.750	±4.900	±2.820	0.150

TABLE 152

MAGNESIUM OXIDE

IDEAL MOLECULAR GAS

MgO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K$: Solid Mg from 0° to 923°K,
Liquid Mg from 923° to 1377°K, Gaseous Mg from 1377° to 6000°K; Gaseous O₂, Gaseous MgO.

T, °K	ΔG_f°	ΔH_f°	$(H_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.112	-10.980	-10.980	INFINITE
298.15	7.506	52.891	52.891	0.000	-11.100	-17.238	12.635
300	7.514	52.918	52.891	0.014	-11.104	-17.276	12.585
400	7.912	55.156	53.191	0.786	-11.296	-19.305	10.547
500	8.211	56.955	53.770	1.593	-11.488	-21.286	9.303
600	8.425	58.472	54.430	2.425	-11.699	-23.225	8.459
700	8.581	59.784	55.103	3.276	-11.934	-25.128	7.845
800	8.698	60.937	55.762	4.140	-12.200	-26.996	7.375
900	8.784	61.967	56.395	5.015	-12.495	-28.827	7.000
923	8.807	62.189	56.537	5.217	-12.568	-29.244	6.924
923	8.807	62.189	56.537	5.217	-14.695	-29.244	6.924
1000	8.862	62.847	57.000	5.847	-14.936	-30.449	6.654
1100	8.924	63.744	57.575	6.787	-15.245	-31.985	6.355
1200	8.977	64.523	58.122	7.682	-15.554	-33.493	6.100
1300	9.023	65.244	58.642	8.582	-15.863	-34.975	5.880
1376.37	9.056	65.764	59.026	9.278	-16.100	-36.106	5.730
1376.37	9.056	65.764	59.026	9.278	-46.840	-36.106	5.730
1400	9.066	65.914	59.138	9.486	-46.846	-35.922	5.607
1500	9.105	66.541	59.611	10.395	-46.869	-35.141	5.120
1600	9.141	67.130	60.063	11.307	-46.892	-34.360	4.693
1700	9.176	67.686	60.496	12.223	-46.915	-33.576	4.316
1800	9.210	68.211	60.910	13.142	-46.936	-32.789	3.981
1900	9.243	68.711	61.308	14.065	-46.957	-32.005	3.681
2000	9.275	69.196	61.690	14.991	-46.978	-31.218	3.411
2100	9.306	69.660	62.059	15.920	-46.999	-30.432	3.167
2200	9.338	70.104	62.414	16.852	-47.020	-29.643	2.945
2300	9.369	70.440	62.757	17.788	-47.039	-28.855	2.742
2400	9.401	70.890	63.088	18.726	-47.059	-28.064	2.555
2500	9.433	71.276	63.409	19.668	-47.079	-27.276	2.384
2600	9.465	71.647	63.719	20.613	-47.098	-26.483	2.226
2700	9.498	72.006	64.021	21.561	-47.118	-25.695	2.080
2800	9.531	72.353	64.313	22.512	-47.137	-24.904	1.944
2900	9.565	72.689	64.597	23.467	-47.156	-24.111	1.817
3000	9.600	73.016	64.874	24.425	-47.176	-23.324	1.699
3098	9.635	73.326	65.138	25.368	-47.195	-22.549	1.591
3098	9.635	73.326	65.138	25.368	-47.195	-22.549	1.591
3100	9.636	73.333	65.143	25.387	-47.195	-22.528	1.588
3200	9.673	73.641	65.405	26.315	-47.215	-21.738	1.485
3300	9.711	73.941	65.661	27.232	-47.236	-20.950	1.387
3400	9.750	74.233	65.911	28.149	-47.258	-20.156	1.296
3500	9.791	74.518	66.155	29.072	-47.281	-19.369	1.209
3600	9.833	74.797	66.393	30.003	-47.306	-18.575	1.128
3700	9.876	75.066	66.626	31.038	-47.331	-17.786	1.051
3800	9.921	75.315	66.854	32.078	-47.360	-16.996	0.977
3900	9.967	75.546	67.078	33.222	-47.390	-16.207	0.908
4000	10.014	75.852	67.297	34.221	-47.423	-15.418	0.842
4100	10.064	76.103	67.511	35.225	-47.460	-14.630	0.780
4200	10.114	76.349	67.722	36.234	-47.500	-13.843	0.720
4300	10.157	76.591	67.929	37.248	-47.544	-13.052	0.663
4400	10.200	76.829	68.132	38.267	-47.594	-12.266	0.609
4500	10.276	77.063	68.332	39.292	-47.647	-11.483	0.558
4600	10.332	77.293	68.528	40.322	-47.707	-10.695	0.508
4700	10.391	77.520	68.721	41.359	-47.772	-9.916	0.461
4800	10.450	77.744	68.911	42.400	-47.846	-9.140	0.415
4900	10.511	77.965	69.098	43.448	-47.927	-8.364	0.372
5000	10.573	78.182	69.282	44.502	-48.016	-7.595	0.330
5100	10.637	78.397	69.464	45.563	-48.115	-6.837	0.290
5200	10.701	78.610	69.643	46.629	-48.226	-6.078	0.251
5300	10.767	78.820	69.819	47.702	-48.349	-5.318	0.214
5400	10.834	79.027	69.993	48.782	-48.485	-4.564	0.178
5500	10.901	79.232	70.165	49.868	-48.637	-3.817	0.144
5600	10.970	79.436	70.335	50.962	-48.807	-3.072	0.111
5700	11.039	79.637	70.503	52.062	-48.996	-2.324	0.078
5800	11.110	79.836	70.669	53.168	-49.212	-1.576	0.047
5900	11.181	80.033	70.833	54.282	-49.453	-0.827	0.017
6000	11.252	80.229	70.995	55.403	-49.725	0.124	-0.012

15 December 1962

RCF

$$\Delta H_{f0}^{\circ} = -10\,980 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -11.100 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^3\Sigma$$

$$S_{298.15}^{\circ} = 52.891 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.112 \text{ kcal gfw}^{-1}$$

State	g	E	cm ⁻¹						
			ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X ³ Σ	3	0	902	13.0	—	0.625	0.000	—	1.2
³ Σ	3	26863.9	817	9.5	—	0.585	0.008	—	1.2
X' ¹ Σ	1	19200.	782.84	5.15	—	0.5711	0.005	—	1.22
A ¹ π	2	22694.4	664.4	3.91	—	0.5056	0.0046	—	1.2
B ¹ Σ	1	39204.7	824.1	4.76	—	0.5822	0.0045	—	1.2

Heat of Formation

Several values of the heat of dissociation of MgO had been reported. An intermediate value adopted. See volume 1, this study (section IVB12.4) for details.

Heat Capacity and Entropy

Calculated using above spectroscopic constants. Brewer and Porter's¹ analysis was given greatest weight.

Reference

1. Brewer, L. and R. Porter, J. Chem. Phys. 22, 1876 (1954).

TABLE 153
MAGNESIUM NITRIDE
CONDENSED PHASE

Mg₃N₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Mg from 0° to 923°K,
Liquid Mg from 923° to 1377°K, Gaseous Mg from 1377° to 6000°K,
Gaseous N₂: α - Mg₃N₂ from 0° to 823°K, β - Mg₃N₂ from 823°
to 1061°K, γ - Mg₃N₂ from 1061° to 2500°K

T °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p	S _T	-(F _T - H ₂₉₈)/T	H _T - H ₂₉₈	ΔH_f°	ΔF_f°	
0							
298.15	24.986	22.400	22.400	0.000	-110.200	-96.255	70.554
300	25.000	22.555	22.400	0.046	-110.200	-96.169	70.056
400	25.730	29.847	23.390	2.583	-110.187	-91.494	49.987
500	26.460	35.667	25.282	5.192	-110.183	-86.822	37.948
600	27.190	40.555	27.431	7.875	-110.208	-82.149	29.921
700	27.920	44.801	29.615	10.630	-110.271	-77.468	24.185
800	28.650	48.577	31.754	13.459	-110.478	-72.774	19.880
823	28.818	49.392	32.235	14.120	-110.417	-71.700	19.039
823	29.600	49.659	32.235	14.340	-110.197	-71.700	19.039
900	29.600	52.306	33.841	16.619	-110.267	-68.086	16.533
923	29.600	53.053	34.311	17.300	-110.307	-67.011	15.866
923	29.600	53.053	34.311	17.300	-116.688	-67.011	15.866
1000	29.600	55.425	35.846	19.579	-116.808	-62.862	13.758
1061	29.600	57.178	37.023	21.384	-116.912	-59.596	12.275
1061	29.540	57.423	37.023	21.644	-116.652	-59.596	12.275
1100	29.540	58.489	37.765	22.796	-116.719	-57.471	11.418
1200	29.540	61.060	39.601	25.750	-116.900	-52.074	9.484
1300	29.540	63.424	41.344	28.704	-117.103	-46.665	7.845
1377	29.540	65.124	42.626	30.979	-117.263	-42.507	6.746
1377	29.540	65.124	42.626	30.979	-209.483	-42.507	6.746
1400	29.540	65.613	43.000	31.658	-209.335	-39.701	6.197
1500	29.540	67.051	44.576	34.612	-208.701	-27.609	4.022
1600	29.540	69.558	46.079	37.566	-208.074	-15.558	2.125
1700	29.540	71.348	47.513	40.520	-207.453	-3.540	0.455
1800	29.540	73.037	48.884	43.474	-206.836	8.441	-1.025
1900	29.540	74.634	50.198	46.428	-206.226	20.379	-2.344
2000	29.540	76.149	51.458	49.382	-205.621	32.286	-3.528
2100	29.540	77.591	52.668	52.336	-205.019	44.168	-4.596
2200	29.540	78.965	53.833	55.290	-204.421	56.022	-5.565
2300	29.540	80.278	54.954	58.244	-203.827	67.847	-6.447
2400	29.540	81.535	56.036	61.198	-203.235	79.646	-7.252
2500	29.540	82.741	57.080	64.152	-202.649	91.420	-7.992

15 June 1961

RED

MAGNESIUM NITRIDE (Mg_3N_2) (CONDENSED PHASE) gfw = 100.976

$\Delta H_{f298.15}^\circ = -110.2 \pm 0.275 \text{ kcal gfw}^{-1}$	$S_{298.15}^\circ = 22.4 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$
$T_{\text{tf}} = 823^\circ \pm 3^\circ \text{K}$	$\Delta H_{\text{t1}} = 0.220 \text{ kcal gfw}^{-1}$
$T_{\text{t2}} = 1061^\circ \pm 5^\circ \text{K}$	$\Delta H_{\text{t2}} = 0.260 \text{ kcal gfw}^{-1}$
$C_p^\circ = 22.81 + 7.30 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1}$	$298.15^\circ \text{K} \leq T \leq 823^\circ \text{K}$
$C_p^\circ = 29.60 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$	$823^\circ \text{K} \leq T \leq 1061^\circ \text{K}$
$C_p^\circ = 29.54 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$	$1061^\circ \text{K} \leq T \leq 2500^\circ \text{K}$

Structure

Low-temperature or α -phase body-centered cubic D5-type; $a = 9.95 \text{ kX}$ (no crystallographic data exist for β and γ phases).

Heat of Formation

Mitchell's¹ value of $-110.2 \pm 0.275 \text{ kcal gfw}^{-1}$ has been used for these calculations.

Heat Capacity and Entropy

Mitchell's¹ value of 22.4 has been used for the entropy; also, his heat-capacity data have been used.

Melting and Vaporization

Magnesium nitride decomposes on heating, and the data are conflicting; accordingly, the γ phase has been extrapolated to 2500°K .

Reference

1. Mitchell, D. W., Ind. Eng. Chem. 41, 2027 (1949).

MAGNESIUM NITRIDE (Mg_3N_2) (CONDENSED PHASE) GFW = 100.976
SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw				Kcal/gfw			Log K _p
	C _p [°]	S _T [°]	-(F _T [°] - H ₂₉₈ [°])/T	H _T [°] - H ₂₉₈ [°]	ΔH _f [°]	ΔF _f [°]		
298.15	* 1.180	* 3.200	* 3.200	* 0.000	± 0.275			
500	* 1.180	* 3.810	* 3.334	* 0.238				
823	* 1.180	* 4.398	* 3.646	* 0.619				
823	* 1.780	* 4.505	* 3.646	* 0.707				
1000	* 1.780	* 4.852	* 3.829	* 1.022				
1061	* 1.780	* 4.957	* 3.891	* 1.131				
1061	* 1.040	* 5.097	* 3.891	* 1.279				
1500	* 1.040	* 5.457	* 4.300	* 1.736				
2000	* 1.040	* 5.756	* 4.628	* 2.256				
2500	* 1.040	* 5.988	* 4.878	* 2.776				

TABLE 154

MANGANESE

REFERENCE STATE

Mn

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K : Solid Mn from 0° to 1517°K,
Liquid Mn from 1517° to 2319°K, Gaseous Mn from 2319° to 6000°K.

T, °K	C_p	C_T	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K _p
0	0.000	0.000	INFINITE	-1.194			
298.15	6.290	7.640	7.640	0.000			
300	6.301	7.679	7.640	0.012			
400	6.822	9.567	7.894	0.669			
500	7.244	11.135	8.390	1.373			
600	7.628	12.490	8.963	2.117			
700	7.993	13.694	9.554	2.898			
800	8.349	14.785	10.141	3.715			
900	8.700	15.788	10.713	4.568			
990	9.012	16.632	11.213	5.365			
990	8.983	17.168	11.213	5.896			
1000	8.990	17.259	11.273	5.985			
1100	9.056	18.119	11.857	6.888			
1200	9.122	18.909	12.412	7.797			
1300	9.188	19.642	12.941	8.712			
1374	9.237	20.152	13.315	9.394			
1374	10.700	20.552	13.315	9.943			
1400	10.700	20.752	13.452	10.221			
1410	10.700	20.829	13.504	10.328			
1410	11.300	21.138	13.504	10.764			
1500	11.300	21.837	13.983	11.781			
1517	11.300	21.964	14.072	11.973			
1517	11.000	24.272	14.072	15.473			
1600	11.000	24.857	14.616	16.386			
1700	11.000	25.524	15.238	17.486			
1800	11.000	26.153	15.827	18.586			
1900	11.000	26.748	16.387	19.686			
2000	11.000	27.312	16.919	20.786			
2100	11.000	27.849	17.427	21.886			
2200	11.000	28.360	17.912	22.986			
2300	11.000	28.849	18.377	24.086			
2318.80	11.000	28.939	18.463	24.295			
2318.80	5.006	51.688	18.463	77.048			
2400	5.018	51.861	19.588	77.454			
2500	5.040	52.066	20.884	77.956			
2600	5.067	52.264	22.086	78.462			
2700	5.101	52.456	23.208	78.970			
2800	5.142	52.642	24.255	79.482			
2900	5.193	52.824	25.238	79.999			
3000	5.253	53.001	26.161	80.521			
3100	5.322	53.174	27.029	81.050			
3200	5.403	53.344	27.848	81.586			
3300	5.495	53.512	28.624	82.131			
3400	5.598	53.677	29.358	82.685			
3500	5.713	53.841	30.055	83.251			
3600	5.841	54.004	30.718	83.828			
3700	5.981	54.166	31.350	84.419			
3800	6.133	54.327	31.952	85.025			
3900	6.297	54.489	32.528	85.646			
4000	6.473	54.650	33.079	86.285			
4100	6.661	54.813	33.608	86.941			
4200	6.859	54.975	34.114	87.617			
4300	7.068	55.139	34.601	88.313			
4400	7.287	55.304	35.070	89.031			
4500	7.515	55.471	35.522	89.771			
4600	7.751	55.638	35.957	90.534			
4700	7.995	55.808	36.377	91.322			
4800	8.244	55.979	36.785	92.134			
4900	8.500	56.151	37.178	92.971			
5000	8.759	56.325	37.558	93.834			
5100	9.022	56.502	37.927	94.723			
5200	9.288	56.679	38.287	95.638			
5300	9.554	56.859	38.636	96.580			
5400	9.821	57.040	38.975	97.549			
5500	10.088	57.222	39.305	98.545			
5600	10.352	57.407	39.627	99.567			
5700	10.614	57.592	39.941	100.615			
5800	10.873	57.779	40.246	101.689			
5900	11.127	57.967	40.546	102.789			
6000	11.376	58.156	40.837	103.914			

15 December 1962

RCF

	0°K to 1517°K	Crystal Liquid Ideal Monatomic Gas
$\Delta H_{f0}^{\circ} = 0$		$\Delta H_{f298.15}^{\circ} = 0$
$\Delta H_{298.15}^{\circ} = 67.000 \text{ kcal gfw}^{-1}$		$S_{298.15}^{\circ} = 7.640 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$
$T_f = 990^{\circ}\text{K}$		$\Delta H_f = 0.511 \text{ kcal gfw}^{-1}$
$T_b = 1374^{\circ}\text{K}$		$\Delta H_b = 0.549 \text{ kcal gfw}^{-1}$
$T_m = 1410^{\circ}\text{K}$		$\Delta H_m = 0.436 \text{ kcal gfw}^{-1}$
$T_m = 1517^{\circ}\text{K}$		$\Delta H_m = 3.500 \text{ kcal gfw}^{-1}$
$T_b = 2319^{\circ}\text{K}$		$\Delta H_v = 52.753 \text{ kcal gfw}^{-1}$
$H_{298.15}^{\circ} - H_0^{\circ} = 1.194 \text{ kcal gfw}^{-1}$		
$C_p^{\circ} = 5.704 + 3.380 \times 10^{-3}T - 0.375 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$		
	$298.15^{\circ}\text{K} \leq T \leq 990^{\circ}\text{K}$	
$C_p^{\circ} = 8.330 + 0.660 \times 10^{-3}T \text{ cal deg K}^{-1} \text{ gfw}^{-1}$		$990^{\circ}\text{K} \leq T \leq 1374^{\circ}\text{K}$
$C_p^{\circ} = 10.700 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$		$1374^{\circ}\text{K} \leq T \leq 1410^{\circ}\text{K}$
$C_p^{\circ} = 11.300 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$		$1410^{\circ}\text{K} \leq T \leq 1517^{\circ}\text{K}$
$C_p^{\circ} = 11.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$		$1517^{\circ}\text{K} \leq T \leq 2319^{\circ}\text{K}$

Structure

Four modifications. Room-temperature form (α - Mn) has b c c.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data reported by several authors adopted. High-temperature data of Naylor^{1,2} adopted and extrapolated to boiling point.

Melting and Vaporization

Determination of Sully³ adopted. Heat of vaporization calculated. See volume 1, this study (section IVA13) for details.

References

1. Naylor, B. F., J. Chem. Phys. 13, 328 (1945).
2. Kelley, K. K., B. F. Naylor, and C. H. Shomate, U. S. Bur. Mines, Tech. Paper 686 (1946).
3. Sully, A. H., Manganese, Metallurgy of the Rare Metals 3, Butterworths, London (1955).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.050	±0.040	±0.040	±0.000			
990	±0.050	±0.070	±0.050	±0.020			
990	±0.050	±0.150	±0.050	±0.100			
1374	±0.100	±0.180	±0.080	±0.130			
1374	±0.200	±0.230	±0.080	±0.210			
1410	±0.300	±0.240	±0.090	±0.220			
1410	±0.500	±0.290	±0.090	±0.280			
1517	±0.500	±0.320	±0.100	±0.330			
1517	±0.500	±0.650	±0.100	±0.830			
2000	±1.610	±0.950	±0.270	±1.350			
2318.80	±2.310	±1.230	±0.380	±1.980			
2318.80	±0.000	±0.002	±0.003	±0.000			
3000	±0.000	±0.002	±0.003	±0.001			
4000	±0.001	±0.003	±0.003	±0.001			
5000	±0.002	±0.003	±0.003	±0.002			
6000	±0.003	±0.003	±0.003	±0.004			

TABLE 156

MANGANESE

IDEAL MONATOMIC GAS

Mn

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mn from 0° to 1517°K,
Liquid Mn from 1517° to 2319°K, Gaseous Mn from 2319° to 6000°K.

T, °K	$\ln \frac{p}{p^\circ}$	$\ln \frac{p}{p^\circ}$	$-(F_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	66.713	66.713	INFINITE
298.15	4.968	41.494	41.494	0.000	67.000	56.907	-41.712
300	4.968	41.525	41.494	0.009	66.997	56.844	-41.409
400	4.968	42.954	41.689	0.506	66.837	53.482	-29.220
500	4.968	44.063	42.057	1.003	66.630	50.167	-21.927
600	4.968	44.968	42.469	1.500	66.383	46.896	-17.081
700	4.968	45.734	42.882	1.996	66.098	43.670	-13.634
800	4.968	46.398	43.281	2.493	65.778	40.488	-11.060
900	4.968	46.983	43.660	2.990	65.422	37.348	-9.060
950	4.968	47.457	43.985	3.437	65.072	34.556	-7.628
990	4.968	47.457	43.985	3.437	64.541	34.556	-7.628
1000	4.968	47.506	44.019	3.487	64.502	34.254	-7.486
1100	4.968	47.980	44.358	3.984	64.096	31.249	-6.208
1200	4.968	48.412	44.678	4.481	63.684	28.281	-5.150
1300	4.968	48.810	44.981	4.977	63.265	25.348	-4.261
1374	4.968	49.085	45.195	5.345	62.951	23.197	-3.690
1374	4.968	49.085	45.195	5.345	62.402	23.197	-3.690
1400	4.968	49.178	45.268	5.474	62.253	22.458	-3.506
1410	4.968	49.213	45.295	5.524	62.196	22.175	-3.437
1410	4.968	49.213	45.295	5.524	61.760	22.175	-3.437
1500	4.968	49.521	45.540	5.971	61.190	19.664	-2.865
1517	4.968	49.577	45.586	6.055	61.082	19.193	-2.765
1517	4.968	49.577	45.586	6.055	57.582	19.193	-2.765
1600	4.969	49.841	45.799	6.468	57.082	17.107	-2.337
1700	4.969	50.143	46.046	6.965	56.479	14.626	-1.880
1800	4.971	50.427	46.281	7.462	55.876	12.183	-1.479
1900	4.973	50.695	46.507	7.959	55.273	9.772	-1.124
2000	4.977	50.951	46.722	8.456	54.670	7.394	-0.808
2100	4.982	51.194	46.930	8.954	54.068	5.044	-0.525
2200	4.991	51.426	47.129	9.453	53.467	2.723	-0.270
2300	5.002	51.648	47.320	9.953	52.867	0.431	-0.041
2318.60	5.005	51.652	47.329	10.000	52.753	0.000	0.000
2318.60	5.005	51.652	47.329	10.000	52.753	0.000	0.000
2400	5.018	51.861	47.505	10.454			
2500	5.040	52.066	47.684	10.956			
2600	5.067	52.264	47.855	11.462			
2700	5.101	52.456	48.023	11.970			
2800	5.142	52.642	48.184	12.482			
2900	5.193	52.824	48.341	12.999			
3000	5.253	53.001	48.494	13.521			
3100	5.322	53.174	48.642	14.050			
3200	5.403	53.344	48.786	14.586			
3300	5.495	53.512	48.927	15.131			
3400	5.598	53.677	49.064	15.685			
3500	5.713	53.841	49.198	16.251			
3600	5.841	54.004	49.330	16.828			
3700	5.981	54.166	49.458	17.419			
3800	6.133	54.327	49.584	18.025			
3900	6.297	54.489	49.708	18.646			
4000	6.473	54.650	49.829	19.285			
4100	6.661	54.813	49.949	19.941			
4200	6.859	54.975	50.067	20.617			
4300	7.068	55.139	50.183	21.313			
4400	7.287	55.304	50.297	22.031			
4500	7.515	55.471	50.410	22.771			
4600	7.751	55.638	50.522	23.534			
4700	7.995	55.808	50.633	24.322			
4800	8.244	55.979	50.742	25.134			
4900	8.500	56.151	50.851	25.971			
5000	8.759	56.325	50.959	26.834			
5100	9.027	56.502	51.066	27.723			
5200	9.288	56.679	51.172	28.638			
5300	9.554	56.859	51.278	29.580			
5400	9.821	57.040	51.383	30.549			
5500	10.088	57.222	51.487	31.545			
5600	10.352	57.407	51.591	32.567			
5700	10.614	57.592	51.695	33.615			
5800	10.873	57.779	51.798	34.689			
5900	11.127	57.967	51.901	35.789			
6000	11.376	58.156	52.004	36.914			

15 December 1962

RGF

$$\Delta H_{f0}^{\circ} = 66.713 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 67.000 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^6S_{2\frac{1}{2}}$$

$$S_{298.15}^{\circ} = 41.494 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Spectroscopic energy levels from Moore.¹

Heat of Formation

An average $\Delta H_{298.15}$ value determined from three calculations. See volume 1, this study (section IVA13) for details.

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

Reference

1. Moore, C., Nat. Bur. Stds. (U.S.) Circ. 467, Vol. II (August 1952).

MANGANESE, MONATOMIC (Mn)

(IDEAL GAS)

GFW = 54.94

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±0.000	±0.002	±0.002	±0.000	±0.300	±0.310	
990					±0.320	±0.350	
990					±0.400	±0.350	
1000	±0.000	±0.002	±0.002	±0.000			
1374					±0.430	±0.410	
1374					±0.510	±0.410	
1410					±0.520	±0.430	
1410					±0.580	±0.430	
1517					±0.630	±0.450	
1517					±1.130	±0.450	
2000	±0.000	±0.002	±0.003	±0.000	±1.650	±0.840	
2318.80					±2.280	±1.180	
3000	±0.000	±0.002	±0.003	±0.001			
4000	±0.001	±0.003	±0.003	±0.001			
5000	±0.002	±0.003	±0.003	±0.002			
6000	±0.003	±0.003	±0.003	±0.004			

TABLE 156

MANGANESE OXIDE

IDEAL MOLECULAR GAS

MnO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mn from 0° to 1517°K,
Liquid Mn from 1517° to 2319°K, Gaseous Mn from 2319° to 6000°K,
Gaseous O₂; Gaseous MnO

T, °K	C_p	S_f°	$(H_f^\circ - H_{298}^\circ)/T$	$(H_f^\circ - H_{298}^\circ)$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.118	31.000	31.000	INFINITE
298.15	7.569	55.616	55.616	0.000	30.600	23.602	-17.300
300	7.577	55.663	55.616	0.014	30.595	23.558	-17.161
400	7.968	57.899	55.918	0.792	30.361	21.247	-11.608
500	8.247	59.709	56.561	1.604	30.104	18.998	-8.304
600	8.439	61.231	57.166	2.439	29.817	16.803	-6.120
700	8.573	62.542	57.843	3.290	29.499	14.658	-4.576
800	8.671	63.694	58.503	4.152	29.144	12.563	-3.432
900	8.744	64.719	59.138	5.023	28.755	10.512	-2.553
990	8.795	65.554	59.683	5.812	28.375	8.706	-1.922
990	8.795	65.554	59.683	5.812	28.375	8.706	-1.922
1000	8.801	65.644	59.743	5.900	27.801	8.513	-1.861
1100	8.846	66.485	60.318	6.783	27.362	6.606	-1.312
1200	8.884	67.256	60.865	7.669	26.915	4.738	-0.863
1300	8.915	67.968	61.384	8.559	26.461	2.909	-0.489
1374	8.936	68.461	61.751	9.270	26.122	1.578	-0.251
1374	8.936	68.461	61.751	9.270	25.573	1.578	-0.251
1400	8.943	68.630	61.878	9.452	25.414	1.126	-0.176
1410	8.943	68.694	61.927	9.542	24.353	0.951	-0.147
1410	8.945	68.644	61.927	9.542	24.917	0.951	-0.147
1500	8.967	69.248	62.349	10.348	24.314	-0.559	0.081
1517	8.971	69.348	62.426	10.501	24.231	-0.838	0.121
1517	8.971	69.348	62.426	10.501	20.701	-0.838	0.121
1600	8.988	69.827	62.749	11.246	20.169	-2.006	0.274
1700	9.008	70.373	63.229	12.145	19.527	-3.373	0.434
1800	9.026	70.886	63.640	13.047	18.884	-4.701	0.571
1900	9.043	71.377	64.035	13.951	18.241	-5.993	0.689
2000	9.059	71.841	64.414	14.856	17.596	-7.252	0.792
2100	9.075	72.284	64.778	15.762	16.949	-8.478	0.882
2200	9.090	72.707	65.129	16.671	16.303	-9.674	0.961
2300	9.105	73.111	65.467	17.580	15.653	-10.840	1.030
2319.40	9.109	73.165	65.529	17.753	15.530	-11.057	1.042
2319.40	9.109	73.185	65.529	17.753	-37.223	-11.057	1.042
2400	9.119	73.699	65.794	18.491	-37.265	-10.144	0.924
2500	9.134	74.192	66.110	19.494	-37.318	-9.011	0.788
2600	9.149	74.631	66.416	20.318	-37.376	-7.881	0.662
2700	9.164	75.076	66.712	21.234	-37.436	-6.745	0.546
2800	9.179	75.490	66.999	22.151	-37.497	-5.610	0.438
2900	9.195	75.833	67.278	23.070	-37.558	-4.468	0.337
3000	9.211	76.145	67.549	23.990	-37.619	-3.326	0.242
3100	9.228	76.428	67.812	24.912	-37.738	-2.181	0.154
3200	9.246	76.642	68.068	25.836	-37.831	-1.037	0.071
3300	9.264	76.827	68.317	26.761	-37.934	0.118	-0.008
3400	9.282	76.974	68.560	27.589	-38.045	1.270	-0.082
3500	9.302	77.094	68.787	28.618	-38.169	2.427	-0.152
3600	9.321	77.237	69.022	29.549	-38.304	3.584	-0.218
3700	9.343	77.443	69.255	30.482	-38.452	4.748	-0.280
3800	9.364	77.743	69.475	31.418	-38.615	5.917	-0.340
3900	9.387	77.987	69.671	32.355	-38.793	7.089	-0.397
4000	9.410	78.276	69.902	33.295	-38.988	8.266	-0.452
4100	9.433	78.459	70.107	34.237	-39.100	9.456	-0.504
4200	9.458	78.686	70.311	35.182	-39.431	10.633	-0.553
4300	9.483	78.911	70.522	36.129	-39.682	11.826	-0.601
4400	9.509	79.130	70.703	37.079	-39.954	13.026	-0.647
4500	9.535	79.345	70.854	38.031	-40.247	14.229	-0.691
4600	9.562	79.556	71.081	38.987	-40.562	15.438	-0.733
4700	9.590	79.763	71.284	39.945	-40.903	16.655	-0.774
4800	9.618	79.967	71.445	40.905	-41.268	17.882	-0.814
4900	9.647	80.166	71.622	41.869	-41.658	19.112	-0.852
5000	9.677	80.363	71.796	42.836	-42.074	20.345	-0.889
5100	9.707	80.556	71.967	43.806	-42.518	21.588	-0.925
5200	9.738	80.746	72.135	44.779	-42.990	22.852	-0.960
5300	9.769	80.934	72.301	45.755	-43.492	24.115	-0.994
5400	9.801	81.118	72.464	46.733	-44.027	25.389	-1.027
5500	9.833	81.300	72.624	47.717	-44.597	26.676	-1.060
5600	9.865	81.479	72.782	48.703	-45.192	27.971	-1.092
5700	9.899	81.656	72.938	49.692	-45.827	29.278	-1.123
5800	9.932	81.830	73.091	50.686	-46.499	30.591	-1.153
5900	9.966	82.002	73.243	51.684	-47.213	31.927	-1.182
6000	10.001	82.172	73.392	52.683	-47.970	33.258	-1.211

15 December 1962

RCF

MANGANESE OXIDE (MnO)

(IDEAL MOLECULAR GAS)

gfw = 70.94

$$\Delta H_{f0}^{\circ} = 31.000 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 30.600 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 4

$$S_{298.15}^{\circ} = 55.616 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.118 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	4	0	839.55	4.79	—	0.499	—	—	0.71
A	2	17909.59	762.75	9.60	0.06	0.453	—	—	0.64

Heat of FormationBased on DasSarma.¹Heat Capacity and EntropyCalculated using above spectroscopic constants based on DasSarma¹ and Herzberg.²References

1. Das Sarma, J. M., Z. Physik 157, 98 (1959).
2. Herzberg, G., Spectra of Diatomic Molecules, I., 2nd ed, Van Nostrand, N. Y. (1950).

TABLE 157

MOLYBDENUM

REFERENCE STATE

Mo

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965°K to 6000°K.

T, °K	$\int_0^T \frac{C_p}{T^2} dT$	$\int_0^T \frac{C_p}{T} dT$	$(F_T - H_{298})/T$	$\frac{H_T}{T} - \frac{H_{298}}{298}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.092			
298.15	5.680	6.830	6.830	0.000			
300	5.690	6.865	6.830	0.011			
400	5.970	8.545	7.057	0.595			
500	6.150	9.905	7.499	1.203			
600	6.280	11.035	7.993	1.825			
700	6.350	12.013	8.499	2.460			
800	6.440	12.868	8.993	3.100			
900	6.550	13.633	9.467	3.750			
1000	6.700	14.329	9.919	4.410			
1100	6.860	14.977	10.349	5.090			
1200	7.050	15.586	10.761	5.790			
1300	7.240	16.162	11.154	6.510			
1400	7.450	16.710	11.531	7.250			
1500	7.680	17.227	11.894	8.000			
1600	7.932	17.731	12.244	8.780			
1700	8.200	18.220	12.580	9.587			
1800	8.486	18.697	12.907	10.421			
1900	8.791	19.163	13.224	11.285			
2000	9.112	19.622	13.532	12.180			
2100	9.451	20.075	13.833	13.108			
2200	9.808	20.523	14.127	14.071			
2300	10.182	20.967	14.415	15.070			
2400	10.574	21.409	14.697	16.107			
2500	10.983	21.849	14.975	17.185			
2600	11.411	22.288	15.247	18.305			
2700	11.855	22.727	15.516	19.468			
2800	12.317	23.166	15.782	20.676			
2890	12.745	23.563	16.018	21.804			
2900	10.000	25.864	16.018	21.454			
2900	10.000	25.899	16.053	28.554			
3000	10.000	26.238	16.387	29.554			
3100	10.000	26.566	16.710	30.554			
3200	10.000	26.887	17.022	31.554			
3300	10.000	27.191	17.326	32.554			
3400	10.000	27.489	17.620	33.554			
3500	10.000	27.779	17.906	34.554			
3600	10.000	28.061	18.185	35.554			
3700	10.000	28.335	18.456	36.554			
3800	10.000	28.602	18.719	37.554			
3900	10.000	28.861	18.975	38.554			
4000	10.000	29.114	19.226	39.554			
4100	10.000	29.361	19.470	40.554			
4200	10.000	29.602	19.708	41.554			
4300	10.000	29.838	19.941	42.554			
4400	10.000	30.068	20.169	43.554			
4500	10.000	30.292	20.391	44.554			
4600	10.000	30.512	20.609	45.554			
4700	10.000	30.727	20.822	46.554			
4800	10.000	30.938	21.031	47.554			
4900	10.000	31.144	21.235	48.554			
4965	10.000	31.276	21.366	49.204			
4965	12.401	60.735	21.366	190.501			
5000	12.500	59.822	21.635	190.936			
5100	12.775	60.072	22.386	191.200			
5200	13.033	60.322	23.112	193.491			
5300	13.275	60.573	23.817	194.806			
5400	13.498	60.813	24.500	196.145			
5500	13.703	61.073	25.163	197.505			
5600	13.889	61.331	25.806	198.885			
5700	14.056	61.569	26.432	200.283			
5800	14.204	61.815	27.040	201.696			
5900	14.334	62.058	27.630	203.123			
6000	14.444	62.300	28.206	204.567			

May 1962

CHW

MOLYBDENUM (Mo)

(REFERENCE STATE)

gfw = 95.95

0°K to 2890°K Crystal

2890°K to 4965°K Liquid

4965°K to 6000°K Ideal Monatomic Gas

$$\Delta H_{f0}^0 = 0$$

$$\Delta H_{f298.15}^0 = 0$$

$$\Delta H_{f298.15}^0 = 158.200 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^0 = 6.83 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2890^\circ\text{K}$$

$$\Delta H_m = 6.650 \text{ kcal gfw}^{-1}$$

$$T_b = 4965^\circ\text{K}$$

$$\Delta H_v = 141.300 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^0 - H_0^0 = 1.092 \text{ kcal gfw}^{-1}$$

$$C_p^0 = 6.026 - 0.217 \times 10^{-3} T + 0.0880 \times 10^{-5} T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 1500^\circ\text{K} \leq T \leq 2890^\circ\text{K}$$

Structure

Mo has a b.c.c. structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data from Stull and Sinke,¹ and Hultgren.² Data to 1500°K from Stull and Sinke.¹ Equation derived from range above 1500°K, based on Rasor and McClelland³ data.

Melting

Melting temperature in agreement with several sources.

VaporizationVapor-pressure data of Edwards *et al*⁴ used.Further details by Barriault *et al*.⁵References

1. Stull, D. R. and G. C. Sinke, *Thermodynamic Properties of Elements*, Am. Chem. Soc., Washington, D. C. (1956).
2. Hultgren, R. *et al*, *Selected Values of Thermodynamic Properties of Metals and Alloys*, Wiley, New York (1963).
3. Rasor, N. and J. McClelland, *J. Phys. Chem. Solids* **15**, 17 (1960).
4. Edwards, J. W. *et al*, *J. Am. Chem. Soc.* **74**, 1539 (1952).
5. Barriault, R. J. *et al*, ASD TR 61-260 (May 1962), Pt. 1.

MOLYBDENUM (Mo)

(REFERENCE STATE)

GFW = 95.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p^0	S_T^0	$-(F_T^0 - H_{298}^0)/T$	$H_T^0 - H_{298}^0$	ΔH_f^0	ΔF_f^0	$\log K_p$
298.15	±0.300	±0.100	±0.100	±0.000			
1000	±0.500	±0.600	±0.320	±0.280			
2000	±0.800	±1.050	±0.580	±0.930			
2890	±2.000	±1.570	±0.820	±2.180			
2890	±2.000	±1.920	±0.820	±3.180			
3000	±2.000	±1.990	±0.860	±3.400			
4000	±3.000	±2.170	±1.240	±5.900			
4965	±4.000	±3.470	±1.600	±9.270			
4965	±0.004	±0.003					
5000	±0.004	±0.003					
6000	±0.005	±0.004					

TABLE 158

MOLYBDENUM

IDEAL MONATOMIC GAS

Mo

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
 Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K.

T, °K	C_p°	S_T°	$\frac{\text{cal/}^\circ\text{K gfw}}{-(F_T^\circ - H_{298}^\circ)/T}$	$\frac{\text{Kcal/gfw}}{H_T^\circ - H_{298}^\circ}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	157.811	157.811	INFINITE
298.15	4.968	43.462	43.462	0.000	158.200	147.278	-107.953
300	4.968	43.493	43.463	0.009	158.198	147.210	-107.237
400	4.968	44.927	43.657	0.506	158.111	153.560	-78.434
500	4.968	46.031	44.025	1.003	158.000	139.937	-61.163
600	4.968	46.937	44.437	1.500	157.875	136.334	-49.657
700	4.968	47.703	44.851	1.996	157.736	132.754	-41.446
800	4.968	48.366	45.249	2.493	157.593	129.195	-35.293
900	4.968	48.951	45.629	2.990	157.440	125.654	-30.512
1000	4.968	49.475	45.988	3.487	157.277	122.131	-26.690
1100	4.969	49.948	46.327	3.984	157.094	118.624	-23.567
1200	4.970	50.381	46.647	4.481	156.891	115.136	-20.968
1300	4.972	50.778	46.949	4.978	156.668	111.666	-18.772
1400	4.977	51.147	47.236	5.475	156.425	108.213	-16.892
1500	4.985	51.491	47.509	5.973	156.173	104.778	-15.265
1600	4.998	51.813	47.768	6.472	155.892	101.362	-13.845
1700	5.017	52.116	48.015	6.973	155.586	97.961	-12.593
1800	5.043	52.404	48.251	7.476	155.255	94.581	-11.483
1900	5.079	52.677	48.476	7.982	154.897	91.221	-10.492
2000	5.125	52.939	48.693	8.492	154.512	87.878	-9.602
2100	5.183	53.190	48.901	9.007	154.099	84.557	-8.799
2200	5.255	53.433	49.102	9.529	153.658	81.299	-8.076
2300	5.340	53.669	49.295	10.059	153.189	77.977	-7.409
2400	5.440	53.898	49.482	10.598	152.691	74.717	-6.804
2500	5.556	54.122	49.663	11.147	152.162	71.480	-6.327
2600	5.689	54.343	49.839	11.710	151.605	68.260	-5.738
2700	5.834	54.560	50.010	12.286	151.018	65.067	-5.267
2800	6.006	54.776	50.176	12.878	150.402	61.897	-4.831
2890	6.171	54.968	50.323	13.426	149.822	59.057	-4.466
2890	6.171	54.968	50.323	13.426	143.172	59.057	-4.466
2900	6.190	54.989	50.339	13.487	143.133	58.771	-4.429
3000	6.392	55.203	50.497	14.116	142.762	55.869	-4.070
3100	6.611	55.416	50.652	14.766	142.412	52.979	-3.735
3200	6.847	55.629	50.805	15.439	142.085	50.096	-3.421
3300	7.099	55.844	50.954	16.136	141.782	47.226	-3.128
3400	7.367	56.060	51.101	16.860	141.506	44.363	-2.852
3500	7.650	56.277	51.246	17.610	141.256	41.510	-2.592
3600	7.946	56.497	51.389	18.390	141.036	38.664	-2.347
3700	8.254	56.719	51.530	19.200	140.846	35.827	-2.116
3800	8.573	56.943	51.669	20.041	140.687	32.992	-1.897
3900	8.901	57.170	51.807	20.915	140.561	30.155	-1.690
4000	9.235	57.400	51.944	21.822	140.468	27.328	-1.493
4100	9.575	57.632	52.080	22.762	140.408	24.498	-1.306
4200	9.917	57.867	52.215	23.736	140.382	21.672	-1.128
4300	10.260	58.104	52.349	24.745	140.391	18.851	-0.958
4400	10.601	58.344	52.483	25.788	140.434	16.020	-0.796
4500	10.939	58.586	52.616	26.865	140.511	13.190	-0.641
4600	11.271	58.830	52.748	27.976	140.622	10.359	-0.492
4700	11.654	59.076	52.880	29.119	140.765	7.529	-0.350
4800	11.909	59.323	53.012	30.295	140.941	4.690	-0.214
4900	12.211	59.572	53.143	31.501	141.147	1.852	-0.083
4965	12.401	59.735	53.229	32.301	141.297	0.000	0.000
4965	12.401	59.735	53.229	32.301			
5000	12.500	59.822	53.277	32.736			
5100	12.775	60.072	53.405	34.000			
5200	13.033	60.322	53.536	35.291			
5300	13.275	60.573	53.666	36.606			
5400	13.498	60.823	53.796	37.945			
5500	13.703	61.073	53.926	39.305			
5600	13.889	61.321	54.056	40.685			
5700	14.056	61.569	54.186	42.083			
5800	14.204	61.815	54.315	43.496			
5900	14.334	62.058	54.444	44.923			
6000	14.444	62.300	54.573	46.362			

May 1962

CHW

MOLYBDENUM (Mo)

(IDEAL MONATOMIC GAS)

gfw = 95.95

$$\Delta H_{f0}^{\circ} = 157.811 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 158.200 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^7S_3$$

$$S_{298.15}^{\circ} = 43.462 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Atomic energy levels from Moore.¹

Heat of Formation

Calculated from vapor-pressure data of Edwards et al.²

Heat Capacity and Entropy

Calculated on monatomic gas-computer program.

Further details by Barriault et al.³

References

1. Moore, C., Atomic Energy Levels, Vol. III, Nat. Bur. Stds. (1958).
2. Edwards, J. et al., J. Am. Chem. Soc. 74, 1539 (1952).
3. Barriault, R. J. et al., ASD TR 61-260 (May 1962), Pt. 1.

MOLYBDENUM, MONATOMIC (Mo)

(IDEAL GAS)

GFW = 95.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal °K gfw			kcal gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔG _f ^o	
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.800	± 0.830	± 0.610
1000	± 0.000	± 0.002	± 0.002	± 0.000	± 1.080	± 1.120	± 0.240
2000	± 0.000	± 0.002	± 0.003	± 0.000	± 1.730	± 1.970	± 0.220
2890	± 0.001	± 0.003	± 0.003	± 0.001	± 2.980	± 3.180	± 0.240
2890	± 0.001	± 0.003	± 0.003	± 0.001	± 3.980	± 3.180	± 0.240
3000	± 0.001	± 0.003	± 0.003	± 0.001	± 4.200	± 3.390	± 0.250
4000	± 0.002	± 0.003	± 0.003	± 0.002	± 6.700	± 5.770	± 0.320
4965	± 0.004	± 0.003	± 0.003	± 0.004	± 0.070	± 8.760	± 0.390
4965	± 0.004	± 0.003	± 0.003	± 0.004			
5000	± 0.004	± 0.003	± 0.003	± 0.004			
6000	± 0.005	± 0.004	± 0.003	± 0.008			

TABLE 159

MOLYBDENUM MONOXIDE

IDEAL MOLECULAR GAS

MoO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K,
Gaseous O₂, Gaseous MoO

T, °K	C_p	$\frac{\text{cal}}{^\circ\text{K gfw}}$ C_p	$\frac{\text{cal}}{^\circ\text{K gfw}}$ C_p	$-(F_1 - H_{298})/T$	$\frac{\text{Kcal}}{\text{gfw}}$ $H_1^\circ - H_{298}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE		-2.116	87.413	87.413	INFINITE
298.15	7.542	54.587	54.587	0.000	0.000	87.400	80.467	-58.981
300	7.550	54.634	54.587	0.014	0.014	87.396	80.424	-58.586
400	7.932	56.861	54.888	0.789	0.789	87.232	78.124	-42.683
500	8.203	58.662	55.469	1.597	1.597	87.067	75.869	-33.161
600	8.388	60.175	56.130	2.427	2.427	86.897	73.643	-26.823
700	8.515	61.478	56.803	3.272	3.272	86.718	71.448	-22.306
800	8.604	62.621	57.461	4.129	4.129	86.537	69.278	-18.925
900	8.669	63.639	58.092	4.992	4.992	86.342	67.133	-16.301
1000	8.717	64.555	58.693	5.862	5.862	86.138	65.010	-14.207
1100	8.754	65.387	59.264	6.735	6.735	85.912	62.906	-12.498
1200	8.783	66.150	59.807	7.612	7.612	85.665	60.827	-11.078
1300	8.806	66.854	60.322	8.492	8.492	85.396	58.767	-9.879
1400	8.824	67.508	60.812	9.373	9.373	85.105	56.729	-8.855
1500	8.839	68.117	61.279	10.256	10.256	84.804	54.714	-7.971
1600	8.851	68.689	61.725	11.141	11.141	84.470	52.717	-7.200
1700	8.861	69.225	62.150	12.027	12.027	84.108	50.743	-6.523
1800	8.870	69.731	62.557	12.913	12.913	83.715	48.794	-5.924
1900	8.877	70.211	62.948	13.800	13.800	83.291	46.862	-5.390
2000	8.883	70.667	63.322	14.688	14.688	82.834	44.958	-4.913
2100	8.889	71.100	63.683	15.577	15.577	82.342	43.073	-4.482
2200	8.893	71.514	64.029	16.466	16.466	81.813	41.219	-4.095
2300	8.898	71.909	64.363	17.356	17.356	81.246	39.385	-3.742
2400	8.901	72.288	64.686	18.246	18.246	80.637	37.579	-3.422
2500	8.904	72.651	64.997	19.136	19.136	79.985	35.800	-3.129
2600	8.907	73.001	65.298	20.027	20.027	79.290	34.047	-2.862
2700	8.910	73.337	65.590	20.917	20.917	78.549	32.314	-2.615
2800	8.912	73.661	65.872	21.809	21.809	77.761	30.621	-2.390
2890	8.914	73.943	66.119	22.611	22.611	77.009	29.117	-2.202
2900	8.914	73.943	66.119	22.611	22.611	77.009	29.117	-2.202
2960	8.914	73.974	66.146	22.700	22.700	77.000	28.980	-2.184
3000	8.916	74.276	66.412	23.591	23.591	69.715	27.564	-2.008
3100	8.918	74.568	66.671	24.483	24.483	69.129	26.167	-1.845
3200	8.919	74.852	66.922	25.375	25.375	68.540	24.790	-1.693
3300	8.921	75.124	67.166	26.267	26.267	67.949	23.433	-1.552
3400	8.922	75.392	67.404	27.159	27.159	67.317	22.093	-1.420
3500	8.923	75.651	67.636	28.051	28.051	66.677	20.766	-1.297
3600	8.924	75.902	67.862	28.944	28.944	66.161	19.465	-1.182
3700	8.925	76.147	68.083	29.836	29.836	65.567	18.178	-1.074
3800	8.926	76.385	68.298	30.729	30.729	64.967	16.906	-0.972
3900	8.927	76.617	68.509	31.621	31.621	64.365	15.639	-0.876
4000	8.928	76.843	68.714	32.514	32.514	63.762	14.408	-0.787
4100	8.928	77.063	68.915	33.407	33.407	63.157	13.177	-0.702
4200	8.929	77.278	69.112	34.300	34.300	62.550	11.966	-0.623
4300	8.930	77.489	69.304	35.193	35.193	61.941	10.776	-0.548
4400	8.930	77.694	69.493	36.086	36.086	61.330	9.583	-0.476
4500	8.931	77.895	69.677	36.979	36.979	60.718	8.415	-0.409
4600	8.931	78.091	69.858	37.872	37.872	60.103	7.263	-0.345
4700	8.932	78.283	70.035	38.765	38.765	59.485	6.124	-0.285
4800	8.932	78.471	70.209	39.658	39.658	58.865	4.992	-0.227
4900	8.933	78.655	70.379	40.551	40.551	58.241	3.886	-0.173
4965	8.933	78.773	70.488	41.132	41.132	57.834	3.168	-0.139
4965	8.933	78.773	70.488	41.132	41.132	57.834	3.168	-0.139
5000	8.933	78.836	70.547	41.645	41.645	57.467	2.775	-0.165
5100	8.933	79.012	70.711	42.338	42.338	56.663	1.534	-0.237
5200	8.934	79.186	70.872	43.231	43.231	55.991	7.311	-0.307
5300	8.934	79.356	71.031	44.125	44.125	55.349	9.111	-0.376
5400	8.934	79.523	71.186	45.018	45.018	54.739	10.930	-0.442
5500	8.935	79.687	71.340	45.912	45.912	54.157	12.760	-0.507
5600	8.935	79.848	71.490	46.805	46.805	53.608	14.610	-0.570
5700	8.935	80.006	71.638	47.699	47.699	53.088	16.484	-0.632
5800	8.935	80.162	71.784	48.592	48.592	52.590	18.380	-0.693
5900	8.936	80.314	71.927	49.486	49.486	52.112	20.278	-0.751
6000	8.936	80.465	72.068	50.379	50.379	51.657	22.218	-0.809

May 1962

CHW

MOLYBDENUM MONOXIDE (MoO) (IDEAL MOLECULAR GAS) gfw = 111.95

$$\Delta H_{f0}^{\circ} = 87.413 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 87.400 \text{ kcal gfw}^{-1}$$

Ground State Configuration = $^1\Sigma$

$$S_{298.15}^{\circ} = 54.587 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.116 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	a_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$^1\Sigma$	1	0.0	840	-	-	0.41076	-	-	-

Heat of Formation

Based on mass spectrometric observations of De Maria et al.¹

Heat Capacity and Entropy

Calculated using above estimated spectroscopic constants. Further details by Barriault, et al.²

References

1. De Maria G. et al, J. Chem. Phys. 32, 1373 (1960).
2. Barriault, R. J., et al, ASD TR 61-260 (May 1962), Pt. 1.

TABLE 160

MOLYBDENUM DIOXIDE

CONDENSED PHASE

MoO₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Mo from 0° to 2890°,
 Liquid Mo from 3890° to 4965°K, Gaseous Mo from 4965° to 6000°K;
 Gaseous O₂; Solid MoO₂.

T, °K	cal/°K gfw			Kcal/gfw			Log K_p
	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
0	0.000	0.000	INFINITE	-1.995	-139.628	-139.628	INFINITE
298.15	13.380	11.060	11.060	0.000	-140.800	-127.450	93.419
300	13.421	11.143	11.060	0.025	-140.799	-127.367	92.782
400	15.075	15.232	11.607	1.450	-140.668	-122.906	67.150
500	16.148	18.730	12.690	3.020	-140.437	-118.489	51.789
600	16.996	21.774	13.957	4.690	-140.145	-114.128	41.569
700	17.739	24.468	15.268	6.440	-139.807	-109.817	34.285
800	18.425	26.898	16.573	8.260	-139.425	-105.559	28.836
900	19.079	29.112	17.845	10.140	-139.009	-101.350	24.610
1000	19.712	31.145	19.075	12.070	-138.567	-97.189	21.240
1100	20.332	33.022	20.258	14.040	-138.116	-93.073	18.491
1200	20.943	34.781	21.398	16.060	-137.644	-89.000	16.208
1300	21.547	36.429	22.491	18.120	-137.161	-84.968	14.284
1400	22.147	37.992	23.542	20.230	-136.655	-80.972	12.640
1500	22.743	39.503	24.556	22.420	-136.085	-77.013	11.220
1600	22.337	41.007	25.538	24.750	-135.412	-73.096	9.984
1700	23.929	42.565	26.494	27.320	-134.532	-69.231	8.900
1800	24.519	44.256	27.434	30.280	-133.295	-65.425	7.943
1900	25.108	46.180	28.369	33.840	-131.493	-61.701	7.097
2000	25.695	48.457	29.317	38.280	-128.848	-58.094	6.348

May 1962

CHW

MOLYBDENUM DIOXIDE (MoO_2) (CONDENSED PHASE) gfw = 127.95

$$\Delta H_{f298.15}^{\circ} = -139.628 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 11.060 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.995 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 14.11 + 5.82 \times 10^{-3} T - 2.18 \times 10^{-5} T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 2000^{\circ}\text{K}$$

Structure

MoO_2 retains a solid structure to its disproportionation temperature.

Heat of Formation

Heat of formation by Mah.¹

Heat Capacity and Entropy

Low-temperature data by King.² High-temperature data by King et al.,³ valid to 1800°K extrapolated to 2000°K.

Melting and Vaporization

MoO_2 disproportionates rather than melts.

Further details by Barriault et al.,⁴

References

1. Mah, A. D., J. Phys. Chem. 61, 1572 (1957).
2. King, E. G., J. Am. Chem. Soc. 80, 1799 (1959).
3. King, E. G. et al., U. S. Bur. Mines, Rept. 5664 (1960).
4. Barriault, R. J. et al., ASD TR 61-260 (May 1962), Pt. 1.

TABLE 161

MOLYBDENUM DIOXIDE

IDEAL MOLECULAR GAS

MoO₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Mo from 0° to 2890°K,
 Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K;
 Gaseous O₂, Gaseous MoO₂

T, °K	$\ln \frac{P}{P^\circ}$	$\ln \frac{T}{T^\circ}$	$(F_f^\circ - H_{298}^\circ)/T^\circ$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-2.670	0.297	0.297	INFINITE
298.15	10.663	63.874	63.874	0.000	-0.200	-2.596	1.903
300	10.681	63.940	63.874	0.020	-0.204	-2.611	1.902
400	11.674	67.151	64.306	1.138	-0.380	-3.386	1.850
500	12.256	69.817	65.149	2.334	-0.523	-4.118	1.800
600	12.677	72.091	66.121	3.582	-0.653	-4.826	1.758
700	12.962	74.068	67.118	4.865	-0.782	-5.513	1.721
800	13.162	75.813	68.098	6.172	-0.913	-6.179	1.688
900	13.307	77.372	69.044	7.496	-1.053	-6.829	1.658
1000	13.414	78.780	69.948	8.832	-1.205	-7.462	1.631
1100	13.496	80.062	70.810	10.178	-1.378	-8.081	1.605
1200	13.559	81.240	71.631	11.531	-1.573	-8.681	1.581
1300	13.609	82.327	72.412	12.889	-1.792	-9.265	1.558
1400	13.649	83.337	73.157	14.252	-2.033	-9.832	1.535
1500	13.682	84.280	73.867	15.619	-2.286	-10.379	1.512
1600	13.709	85.164	74.546	16.988	-2.574	-10.909	1.490
1700	13.731	85.995	75.195	18.360	-2.892	-11.422	1.468
1800	13.750	86.781	75.817	19.734	-3.241	-11.912	1.446
1900	13.767	87.525	76.414	21.110	-3.623	-12.384	1.424
2000	13.780	88.231	76.967	22.488	-4.040	-12.834	1.402
2100	13.792	88.904	77.539	23.866	-4.496	-13.264	1.380
2200	13.803	89.546	78.070	25.246	-4.990	-13.669	1.358
2300	13.812	90.160	78.583	26.627	-5.524	-14.053	1.335
2400	13.820	90.748	79.077	28.008	-6.102	-14.410	1.312
2500	13.827	91.312	79.556	29.391	-6.725	-14.745	1.289
2600	13.833	91.854	80.018	30.774	-7.394	-15.051	1.265
2700	13.839	92.376	80.466	32.157	-8.112	-15.333	1.241
2800	13.844	92.880	80.901	33.541	-8.875	-15.585	1.216
2890	13.848	93.317	81.271	34.788	-9.612	-15.762	1.192
2890	13.848	93.317	81.271	34.788	-16.262	15.762	1.192
2900	13.848	93.366	81.322	34.926	-16.319	-15.785	1.190
3000	13.852	93.835	81.732	36.311	-16.886	-15.759	1.148
3100	13.856	94.290	82.129	37.696	-17.458	-15.708	1.107
3200	13.859	94.729	82.516	39.082	-18.034	-15.648	1.069
3300	13.862	95.156	82.893	40.468	-18.613	-15.563	1.031
3400	13.865	95.570	83.260	41.855	-19.194	-15.463	0.994
3500	13.868	95.972	83.617	43.241	-19.777	-15.341	0.958
3600	13.870	96.363	83.966	44.628	-20.371	-15.206	0.923
3700	13.872	96.743	84.306	46.015	-20.969	-15.052	0.889
3800	13.874	97.113	84.638	47.403	-21.566	-14.885	0.856
3900	13.876	97.473	84.963	48.790	-22.168	-14.703	0.824
4000	13.878	97.824	85.280	50.178	-22.772	-14.500	0.792
4100	13.879	98.167	85.590	51.566	-23.380	-14.289	0.762
4200	13.881	98.501	85.893	52.954	-23.992	-14.057	0.731
4300	13.882	98.828	86.190	54.342	-24.607	-13.807	0.702
4400	13.884	99.147	86.481	55.730	-25.227	-13.548	0.673
4500	13.885	99.459	86.766	57.119	-25.849	-13.280	0.645
4600	13.886	99.764	87.046	58.507	-26.477	-12.990	0.617
4700	13.887	100.063	87.319	59.896	-27.109	-12.690	0.590
4800	13.888	100.355	87.588	61.284	-27.748	-12.374	0.563
4900	13.889	100.642	87.851	62.673	-28.392	-12.044	0.537
4965	13.890	100.824	88.019	63.576	-28.816	-11.817	0.520
4965	13.890	100.824	88.019	63.576	-170.113	-11.817	0.520
5000	13.890	100.922	88.110	64.062	-170.426	-10.705	0.468
5100	13.890	101.198	88.364	65.451	-171.351	-7.502	0.321
5200	13.891	101.467	88.613	66.840	-172.313	-4.280	0.180
5300	13.892	101.732	88.858	68.229	-173.312	-1.039	0.043
5400	13.893	101.992	89.099	69.619	-174.349	2.225	-0.090
5500	13.893	102.246	89.336	71.008	-175.425	5.511	-0.219
5600	13.894	102.497	89.569	72.397	-176.543	8.803	-0.344
5700	13.895	102.743	89.798	73.787	-177.703	12.135	-0.465
5800	13.895	102.984	90.023	75.176	-178.911	15.480	-0.496
5900	13.896	103.222	90.245	76.567	-180.169	18.839	-0.698
6000	13.896	103.455	90.463	77.955	-181.484	22.236	-0.810

May 1962

CHW

MOLYBDENUM DIOXIDE (MoO₂) (IDEAL MOLECULAR GAS) gfw = 127.95

$$\Delta H_{f0}^{\circ} = 0.297 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -0.200 \text{ kcal gfw}^{-1}$$

Point Group = C_{2v}

$$S_{298.15}^{\circ} = 63.874 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.670 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega \text{ cm}^{-1}$	$\omega \text{ cm}^{-1}$
824 (1)	857 (1)
367 (1)	

Bond lengths and angles:

Mo-O distance = 1.73 Å

O-Mo-O Angle = 107 deg

Product of moments of inertia: $I_A I_B I_C = 6.2826 \times 10^{-115} \text{ g}^3 \text{ cm}^6$, $\sigma = 2$

Heat of Formation

Average of calculations based on data by DeMaria et al.¹ and by Burns et al.²

Heat Capacity and Entropy

Calculated on polyatomic gas-computer program using estimated spectroscopic constants.

Further details by Barriault et al.³

References

1. DeMaria, G. et al, J. Chem. Phys. 32, 1373 (1960).
2. Burns, R. et al, J. Chem. Phys. 32, 1363 (1960).
3. Barriault, R. et al, ASD TR 61-260 (May 1962), Pt. 1.

TABLE 162

MOLYBDENUM TRIOXIDE

CONDENSED PHASE



Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K;
Gaseous O₂, Solid MoO₃ from 0° to 1070°K, Liquid MoO₃ from 1070°
to 1500°K.

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	C _T ^o	$-(F_T^\circ - H_{298}^\circ)/T$	H _T ^o - H ₂₉₈ ^o	ΔH_f°	ΔF_f°	
0	0.000	0.000	INFINITE	-3.009	-176.905	-176.905	INFINITE
298.15	17.934	18.580	18.580	0.000	-178.100	-159.686	117.048
300	17.977	18.691	18.581	0.033	-178.098	-159.572	116.243
400	19.777	24.130	19.310	1.928	-177.851	-153.431	83.827
500	21.030	28.684	20.742	3.971	-177.513	-147.361	64.408
600	22.067	32.612	22.400	6.127	-177.113	-141.369	51.491
700	23.001	36.084	24.111	6.381	-176.659	-135.447	42.286
800	23.882	39.213	25.805	10.726	-176.152	-129.593	35.401
900	24.731	42.076	27.457	13.157	-175.591	-123.807	30.063
1000	25.560	44.724	29.053	15.671	-174.979	-118.084	25.806
1070	26.133	46.473	30.136	17.481	-174.526	-114.123	23.309
1070	30.200	57.392	30.136	29.164	-162.843	-114.123	23.309
1100	30.200	58.227	30.891	30.070	-162.519	-112.756	22.401
1200	30.200	60.855	33.280	33.090	-161.471	-108.277	19.719
1300	30.200	63.272	35.495	36.110	-160.456	-103.887	17.464
1400	30.200	65.511	37.561	39.130	-159.471	-99.576	15.544
1500	30.200	67.594	39.494	42.150	-158.508	-95.331	13.889

MOLYBDENUM TRIOXIDE (MoO₃) (CONDENSED PHASE) gfw = 143.95

$$\Delta H_{f298.15}^{\circ} = -178.100 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 18.58 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 1070^{\circ}\text{K}$$

$$\Delta H_m = 11.683 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.009 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 17.97 + 7.80 \times 10^{-3}T - 2.10 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 1070^{\circ}\text{K}$$

$$C_p^{\circ} = 30.2 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$1070^{\circ}\text{K} \leq T \leq 1500^{\circ}\text{K}$$

Structure

MoO₃ melts at 1070°K.

Heat of Formation

Based on Mah.¹

Heat Capacity and Entropy

Low-temperature data from Kelley and King.² High-temperature data by King et al.³

Melting and Vaporization

The melting point is an average of four values.

Further details given by Barriault et al.⁴

References

1. Mah, A. D., J. Phys. Chem. 61, 1572 (1957).
2. Kelley, K. and E. King, U. S. Bur. Mines, Bull. 592 (1961).
3. King, E. et al., U. S. Bur. Mines, Rept. 5664 (1960).
4. Barriault, R. et al., ASD TR 61-260 (May 1962), Pt. 1.

TABLE 163

MOLYBDENUM TRIOXIDE

IDEAL MOLECULAR GAS

MoO₃

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Mo from 0° to 2890°K,
 Liquid Mo from 2890° to 4965°K, Gaseous Mo from 4965° to 6000°K,
 Gaseous O₂, Gaseous MoO₃

T, °K	C_p	$\int_0^T C_p dT$	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-3.227	-80.023	-80.023	INFINITE
298.15	14.498	66.653	66.653	0.000	-81.000	-76.919	56.381
300	14.533	66.742	66.653	0.027	-81.004	-76.894	56.014
400	16.105	71.153	67.244	1.564	-81.115	-75.504	41.252
500	17.147	74.867	68.407	3.230	-81.154	-74.094	32.385
600	17.838	78.059	69.756	4.982	-81.158	-72.682	26.473
700	18.308	80.846	71.145	6.790	-81.150	-71.271	22.251
800	18.637	83.313	72.515	8.639	-81.139	-69.861	19.084
900	18.876	85.523	73.840	10.515	-81.133	-68.451	16.621
1000	19.052	87.521	75.110	12.412	-81.138	-67.041	14.651
1100	19.186	89.344	76.322	14.324	-81.165	-65.629	13.039
1200	19.291	91.018	77.478	16.248	-81.213	-64.216	11.695
1300	19.374	92.565	78.580	18.181	-81.285	-62.798	10.557
1400	19.440	94.004	79.631	20.122	-81.380	-61.373	9.580
1500	19.494	95.347	80.634	22.069	-81.489	-59.940	8.733
1600	19.539	96.604	81.593	24.021	-81.613	-58.496	7.990
1700	19.576	97.772	82.512	25.977	-81.750	-57.049	7.334
1800	19.607	98.852	83.392	27.936	-82.000	-55.586	6.749
1900	19.634	99.873	84.237	29.898	-82.259	-54.110	6.224
2000	19.657	100.781	85.049	31.862	-82.540	-52.620	5.750
2100	19.677	101.590	85.831	33.829	-82.860	-51.116	5.319
2200	19.694	102.356	86.584	35.798	-83.221	-49.597	4.927
2300	19.709	103.073	87.311	37.768	-83.624	-48.059	4.566
2400	19.722	103.751	88.013	39.739	-84.072	-46.507	4.235
2500	19.734	104.376	88.691	41.712	-84.569	-44.930	3.928
2600	19.744	104.950	89.348	43.686	-85.113	-43.334	3.642
2700	19.753	105.476	89.984	45.661	-85.709	-41.715	3.376
2800	19.762	105.954	90.601	47.637	-86.353	-40.071	3.128
2890	19.768	106.234	91.140	49.415	-86.983	-38.576	2.917
2900	19.768	106.255	91.140	49.415	-86.983	-38.576	2.917
3000	19.769	106.308	91.220	49.613	-87.077	-38.384	2.893
3100	19.776	106.378	91.281	51.590	-87.428	-36.668	2.657
3200	19.782	106.426	92.346	53.568	-87.866	-34.531	2.434
3300	19.787	106.455	92.896	55.547	-88.390	-32.598	2.226
3400	19.792	106.464	93.432	57.526	-88.995	-30.871	2.029
3500	19.797	106.455	93.953	59.505	-89.682	-28.665	1.843
3600	19.801	106.428	94.461	61.485	-90.447	-26.670	1.665
3700	19.805	106.386	94.957	63.466	-91.292	-24.667	1.497
3800	19.809	106.329	95.441	65.446	-92.215	-22.655	1.338
3900	19.812	106.257	95.913	67.427	-93.219	-20.626	1.186
4000	19.815	106.172	96.375	69.409	-94.305	-18.584	1.041
4100	19.818	106.074	96.826	71.390	-95.478	-16.528	0.903
4200	19.821	105.963	97.267	73.372	-96.740	-14.461	0.771
4300	19.823	105.841	97.699	75.354	-98.098	-12.382	0.644
4400	19.825	105.707	98.122	77.337	-99.559	-10.281	0.523
4500	19.827	105.563	98.546	79.319	-101.124	-8.180	0.406
4600	19.829	105.409	98.941	81.302	-102.793	-6.066	0.295
4700	19.831	105.244	99.339	83.285	-104.564	-3.933	0.187
4800	19.833	105.079	99.729	85.269	-106.436	-1.791	0.083
4900	19.835	104.914	100.111	87.252	-108.409	0.370	-0.017
5000	19.836	104.750	100.486	89.235	-110.486	2.533	-0.113
5100	19.837	104.585	100.854	91.219	-112.669	4.710	-0.214
5200	19.838	104.421	101.216	93.203	-114.960	6.903	-0.320
5300	19.839	104.257	101.571	95.187	-117.360	9.116	-0.431
5400	19.841	104.094	101.920	97.171	-119.870	11.351	-0.546
5500	19.843	103.931	102.263	99.155	-122.490	13.606	-0.665
5600	19.844	103.769	102.600	101.139	-125.220	15.881	-0.788
5700	19.845	103.607	102.937	103.124	-128.060	18.176	-0.914
5800	19.846	103.446	103.278	105.109	-131.010	20.491	-1.041
5900	19.847	103.285	103.615	107.094	-134.070	22.826	-1.168
6000	19.848	103.124	103.950	109.079	-137.240	25.181	-1.295

May 1962

CHW

MOLYBDENUM TRIOXIDE (MoO_3) (IDEAL MOLECULAR GAS) $\text{gfw} = 143.95$

$$\Delta H_{f0}^{\circ} = -80.023 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -81.000 \text{ kcal gfw}^{-1}$$

Point Group = D_{3h}

$$S_{298.15}^{\circ} = 66.653 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.227 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
800 (1)	897 (2)
344 (1)	317 (2)

Bond lengths and angles:

Mo-O distance = 1.73 Å

O-Mo-O Angle = 120 deg

Product of moments of inertia: $I_A I_B I_C = 3.392032 \times 10^{-114} \text{ g}^3 \text{ cm}^6$, $\sigma = 6$

Heat of Formation

An average based on the works of DeMaria et al¹ and Burns et al.²

Heat Capacity and Entropy

Calculated on polyatomic gas-computer program using estimated spectroscopic constants.

Further details given by Barriault et al.³

References

1. DeMaria, G. et al, J. Chem. Phys. 32, 1373 (1960).
2. Burns, R. et al, J. Chem. Phys. 32, 1363 (1960).
3. Barriault, R. J. et al, ASD TR 61-260 (May 1962), Pt. 1.

TABLE 164

NITROGEN

IDEAL MONATOMIC GAS

N

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p :
Gaseous N_2 from 0° to 6000°K

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.481	112.536	112.536	INFINITE
298.15	4.968	36.615	36.615	0.000	112.980	108.887	-79.812
300	4.968	36.645	36.615	0.009	112.983	108.861	-79.301
400	4.968	38.074	36.809	0.506	113.131	107.465	-58.713
500	4.968	39.183	37.177	1.003	113.277	106.032	-46.344
600	4.968	40.089	37.590	1.500	113.417	104.569	-38.087
700	4.968	40.855	38.003	1.996	113.550	103.084	-32.183
800	4.968	41.518	38.402	2.493	113.675	101.580	-27.749
900	4.968	42.103	38.781	2.990	113.792	100.061	-24.297
1000	4.968	42.627	39.140	3.487	113.902	98.530	-21.533
1100	4.968	43.100	39.479	3.984	114.005	96.987	-19.269
1200	4.968	43.533	39.799	4.481	114.101	95.437	-17.381
1300	4.968	43.930	40.101	4.977	114.192	93.879	-15.782
1400	4.968	44.298	40.388	5.474	114.278	92.312	-14.410
1500	4.968	44.641	40.661	5.971	114.361	90.740	-13.220
1600	4.968	44.967	40.919	6.468	114.440	89.164	-12.179
1700	4.968	45.263	41.166	6.965	114.516	87.580	-11.259
1800	4.968	45.547	41.402	7.461	114.587	85.993	-10.440
1900	4.969	45.816	41.627	7.958	114.658	84.402	-9.708
2000	4.969	46.070	41.843	8.455	114.726	82.810	-9.049
2100	4.970	46.313	42.050	8.952	114.792	81.211	-8.451
2200	4.971	46.544	42.249	9.449	114.857	79.610	-7.908
2300	4.972	46.765	42.441	9.946	114.920	78.006	-7.412
2400	4.975	46.977	42.625	10.444	114.982	76.402	-6.957
2500	4.978	47.180	42.803	10.941	115.042	74.792	-6.538
2600	4.982	47.375	42.976	11.439	115.102	73.179	-6.151
2700	4.987	47.563	43.142	11.938	115.162	71.567	-5.793
2800	4.993	47.745	43.303	12.437	115.221	69.952	-5.460
2900	5.001	47.920	43.459	12.936	115.278	68.334	-5.150
3000	5.010	48.090	43.611	13.437	115.337	66.714	-4.860
3100	5.022	48.254	43.758	13.938	115.397	65.091	-4.589
3200	5.035	48.414	43.901	14.441	115.455	63.469	-4.335
3300	5.050	48.569	44.040	14.945	115.515	61.843	-4.095
3400	5.066	48.720	44.176	15.451	115.575	60.215	-3.870
3500	5.085	48.867	44.308	15.959	115.638	58.584	-3.658
3600	5.107	49.011	44.436	16.468	115.700	56.956	-3.458
3700	5.130	49.151	44.562	16.980	115.760	55.323	-3.268
3800	5.155	49.288	44.684	17.494	115.83	53.691	-3.088
3900	5.183	49.422	44.804	18.011	115.902	52.054	-2.917
4000	5.213	49.554	44.921	18.531	115.973	50.416	-2.754
4100	5.244	49.683	45.036	19.054	116.048	48.774	-2.600
4200	5.278	49.810	45.148	19.580	116.124	47.132	-2.452
4300	5.314	49.935	45.258	20.110	116.205	45.487	-2.312
4400	5.351	50.057	45.366	20.643	116.287	43.843	-2.178
4500	5.390	50.178	45.471	21.180	116.374	42.195	-2.049
4600	5.431	50.297	45.575	21.721	116.465	40.544	-1.926
4700	5.473	50.414	45.676	22.266	116.558	38.899	-1.809
4800	5.517	50.530	45.776	22.816	116.656	37.246	-1.696
4900	5.562	50.644	45.875	23.369	116.758	35.584	-1.587
5000	5.608	50.757	45.971	23.928	116.864	33.930	-1.483
5100	5.654	50.866	46.066	24.491	116.974	32.267	-1.383
5200	5.702	50.978	46.159	25.059	117.089	30.607	-1.286
5300	5.751	51.088	46.251	25.632	117.208	28.948	-1.194
5400	5.800	51.195	46.342	26.209	117.332	27.277	-1.104
5500	5.850	51.302	46.431	26.792	117.460	25.612	-1.018
5600	5.899	51.408	46.519	27.379	117.592	23.940	-0.934
5700	5.950	51.513	46.606	27.971	117.730	22.266	-0.854
5800	6.000	51.617	46.691	28.569	117.872	20.592	-0.776
5900	6.050	51.720	46.776	29.171	118.019	18.910	-0.700
6000	6.100	51.822	46.859	29.779	118.170	17.226	-0.627

May 1962

RCF

NITROGEN, MONATOMIC (N)

(IDEAL GAS)

gfw = 14.008

$$\Delta H_{f0}^{\circ} = 112.536 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 112.980 \text{ kcal gfw}^{-1}$$

Ground State Configuration $S_{1-1/2}^4$

$$S_{298.15}^{\circ} = 36.615 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Atomic energy levels from Moore.¹

Heat of Formation

Based on review by Brewer and Searcy.²

Heat Capacity and Entropy

Calculated on monatomic gas-computer program.

Further details in report by Barriault *et al.*³

References

1. Moore, C. Atomic Energy Levels, Vol. 1, Nat. Bur. Stds. (1949).
2. Brewer, L. and A. Searcy, Ann. Rev. Phys. Chem. 8, 259 (1956).
3. Barriault, R. *et al.*, ASD TR 61-260 (May 1962), Pt. I.

NITROGEN, MONATOMIC (N)

(IDEAL GAS)

GFW = 14.008

SUMMARY OF UNCERTAINTY ESTIMATES

T °K	cal °K gfw			kcal gfw			
	C_p	S_T	$(H_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f	ΔG_f	$\log K_p$
298.15	±0.000	±0.002	±0.002	±0.000	±0.100	±0.100	0.070
1000	±0.000	±0.002	±0.002	±0.000	±0.100	±0.100	0.020
2000	±0.000	±0.002	±0.002	±0.000	±0.100	±0.110	0.010
3000	±0.000	±0.002	±0.002	±0.001	±0.100	±0.110	0.010
4000	±0.000	±0.002	±0.002	±0.001	±0.100	±0.120	0.005
5000	±0.001	±0.002	±0.002	±0.001	±0.100	±0.120	0.005
6000	±0.001	±0.002	±0.003	±0.002	±0.100	±0.130	0.005

TABLE 165

NIOBIUM NITRIDE

CONDENSED PHASE

NNb

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$. Solid Nb from 0° to 2741°K,
Liquid Nb from 2741° to 5031°K, Gaseous Nb from 5031° to 6000°K;
Gaseous N_2 , Solid NbN from 0° to 2323°K, Liquid NbN from 2323°
to 6000°K

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.846	-56.046	-56.046	INFINITE
298.15	10.300	10.500	10.500	0.000	-56.500	-56.124	36.740
300	10.310	10.564	10.500	0.019	-56.498	-56.084	36.485
400	10.850	13.604	10.911	1.077	-56.389	-47.961	26.204
500	11.390	16.083	11.705	2.189	-56.237	-45.872	20.050
600	11.930	18.207	12.615	3.355	-56.047	-43.815	15.959
600	11.930	18.207	12.615	3.355	-56.047	-43.815	15.959
700	12.128	20.061	13.550	4.558	-55.835	-41.794	13.048
800	12.327	21.694	14.468	5.781	-55.622	-39.803	10.873
900	12.525	23.157	15.353	7.023	-55.408	-37.838	9.188
1000	12.724	24.487	16.201	8.286	-55.189	-35.898	7.845
1100	12.922	25.709	17.011	9.568	-54.968	-33.979	6.751
1200	13.121	26.842	17.783	10.870	-54.742	-32.081	5.842
1300	13.319	27.906	18.521	12.192	-54.512	-30.202	5.077
1400	13.518	28.894	19.227	13.534	-54.276	-28.340	4.424
1500	13.716	29.834	19.903	14.896	-54.034	-26.496	3.860
1600	13.915	30.725	20.552	16.277	-53.786	-24.669	3.369
1643	14.000	31.095	20.823	16.877	-53.676	-23.888	3.177
1643	15.000	31.704	20.823	17.877	-52.676	-23.888	3.177
1700	15.000	32.215	21.196	18.732	-52.476	-22.893	2.943
1800	15.000	33.073	21.833	20.232	-52.134	-21.163	2.569
1900	15.000	33.884	22.446	21.732	-51.805	-19.451	2.237
2000	15.000	34.653	23.037	23.232	-51.487	-17.755	1.940
2100	15.000	35.385	23.608	24.732	-51.180	-16.077	1.673
2200	15.000	36.083	24.159	26.232	-50.885	-14.413	1.436
2300	15.000	36.750	24.692	27.732	-50.601	-12.760	1.212
2323	15.000	36.899	24.812	28.077	-50.537	-12.073	1.136
2323	15.000	41.634	24.812	28.077	-39.537	-12.073	1.136
2400	15.000	42.133	25.360	40.232	-39.329	-11.488	1.046
2500	15.000	42.736	26.053	41.732	-39.067	-10.331	0.903
2600	15.000	43.324	26.696	43.232	-38.816	-9.187	0.772
2700	15.000	43.897	27.322	44.732	-38.575	-8.051	0.652
2741	15.000	44.116	27.572	45.347	-38.480	-7.591	0.605
2741	15.000	44.116	27.572	45.347	-38.480	-7.591	0.605
2800	15.000	44.436	27.934	46.000	-38.480	-7.591	0.605
2900	15.000	44.862	28.500	47.732	-38.480	-6.435	0.410
3000	15.000	45.270	29.060	49.232	-38.480	-5.279	0.299
3100	15.000	45.662	29.597	50.732	-38.480	-4.123	0.195
3200	15.000	46.039	30.116	52.232	-38.480	-2.967	0.098
3300	15.000	46.400	30.618	53.732	-38.480	-1.811	0.008
3400	15.000	46.746	31.103	55.232	-38.480	-0.655	-0.076
3500	15.000	47.083	31.573	56.732	-38.480	0.499	-0.155
3600	15.000	47.416	32.030	58.232	-38.480	1.643	-0.229
3700	15.000	47.746	32.477	59.732	-38.480	2.787	-0.299
3800	15.000	48.073	32.913	61.232	-38.480	3.931	-0.365
3900	15.000	48.396	33.341	62.732	-38.480	5.075	-0.427
4000	15.000	48.716	33.758	64.232	-38.480	6.219	-0.486
4100	15.000	49.036	34.164	65.732	-38.480	7.363	-0.541
4200	15.000	49.356	34.561	67.232	-38.480	8.507	-0.593
4300	15.000	49.673	34.958	68.732	-38.480	9.651	-0.643
4400	15.000	49.989	35.353	70.232	-38.480	10.795	-0.690
4500	15.000	50.306	35.750	71.732	-38.480	11.939	-0.735
4600	15.000	50.623	36.147	73.232	-38.480	13.083	-0.778
4700	15.000	50.940	36.544	74.732	-38.480	14.227	-0.818
4800	15.000	51.257	36.941	76.232	-38.480	15.371	-0.856
4900	15.000	51.574	37.338	77.732	-38.480	16.515	-0.893
5000	15.000	51.891	37.735	79.232	-38.480	17.659	-0.928
5031.58	15.000	52.208	38.132	80.732	-38.480	18.803	-0.936
5031.58	15.000	52.525	38.529	82.232	-38.480	19.947	-0.936
5100	15.000	52.842	38.926	83.732	-38.480	21.091	-1.054
5200	15.000	53.159	39.323	85.232	-38.480	22.235	-1.120
5300	15.000	53.476	39.720	86.732	-38.480	23.379	-1.180
5400	15.000	53.793	40.117	88.232	-38.480	24.523	-1.233
5500	15.000	54.110	40.514	89.732	-38.480	25.667	-1.281
5600	15.000	54.427	40.911	91.232	-38.480	26.811	-1.323
5700	15.000	54.744	41.308	92.732	-38.480	27.955	-1.360
5800	15.000	55.061	41.705	94.232	-38.480	29.099	-1.393
5900	15.000	55.378	42.102	95.732	-38.480	30.243	-1.421
6000	15.000	55.695	42.499	97.232	-38.480	31.387	-1.445

NIOBIUM NITRIDE (NbN)

(CONDENSED PHASE)

gfw = 106.918

$$\Delta H_{f,298.15}^{\circ} = -56.5 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 10.5 \text{ cal degK}^{-1}\text{gfw}^{-1}$$

$$T_f = 1643^{\circ}\text{K}$$

$$\Delta H_f = 1.0 \text{ kcal gfw}^{-1}$$

$$T_m = 2323^{\circ}\text{K}$$

$$\Delta H_m = 11.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.846 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 8.69 + 5.40 \times 10^{-3}T \text{ cal degK}^{-1}\text{gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 600^{\circ}\text{K}$$

$$C_p^{\circ} = 10.7391 + 1.9847 \times 10^{-3}T \text{ cal degK}^{-1}\text{gfw}^{-1}$$

$$600^{\circ}\text{K} \leq T \leq 1643^{\circ}\text{K}$$

$$C_p^{\circ} = 15.0 \text{ cal degK}^{-1}\text{gfw}^{-1}$$

$$1643^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

Low-temperature form is hcp. Above 1643°K, it is consider to be fcc.

Heat of Formation

Based on combustion data of Mah and Gellert.¹

Heat Capacity and Entropy

Low-temperature data estimated. Data from 298.15° to 600°K based on Kelley.² Data above 600°K estimated.

Melting and Vaporization

Heats of transition and melting estimated.

References

1. Mah, A. D. and N. L. Gellert, J. Am. Chem. Soc. 78, 3261 (1956).
2. K. K. Kelley, U. S. Bur. Mines, Bull. 584 (1960).

NIOBIUM NITRIDE (NbN)

(CONDENSED PHASE)

GFW = 106.918

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.500	± 1.000	± 1.000	± 0.000	± 0.400		
600	± 0.500	± 1.350	± 1.098	± 0.151			
600	± 1.000	± 1.350	± 1.098	± 0.151			
1000	± 1.000	± 1.860	± 1.310	± 0.551			
1643	± 1.000	± 2.357	± 1.630	± 1.194			
1643	± 2.000	± 2.966	± 1.630	± 2.194			
2000	± 2.000	± 3.359	± 1.905	± 2.908			
2323	± 2.000	± 3.658	± 2.128	± 3.554			
2323	± 2.000	± 5.380	± 2.128	± 7.554			
3000	± 2.000	± 5.892	± 2.922	± 8.908			
4000	± 2.000	± 6.467	± 3.740	± 10.908			
5000	± 2.000	± 6.913	± 4.332	± 12.908			
6000	± 2.000	± 7.278	± 4.793	± 14.908			

TABLE 166

DINIOBIUM NITRIDE

CONDENSED PHASE

Nb₂N

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Nb from 0° to 2741°K,
 Liquid Nb from 2741° to 5031°K, Gaseous Nb from 5031° to 6000°K;
 Gaseous N₂, Solid Nb₂N from 0° to 2673°K

T, °K	G_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.938	-59.874	-59.874	INFINITE
298.15	16.130	19.000	19.000	0.000	-60.500	-53.975	39.563
300	16.138	19.100	19.000	0.030	-60.498	-53.934	39.289
400	16.547	21.798	19.538	1.664	-60.413	-51.756	28.278
500	16.955	27.534	20.856	3.379	-60.307	-49.608	21.682
600	17.364	30.662	22.217	5.055	-60.186	-47.478	17.293
700	17.773	33.369	23.618	6.812	-60.048	-45.372	14.165
800	18.182	35.769	25.007	8.610	-59.898	-43.284	11.824
900	18.591	37.915	26.375	10.448	-59.736	-41.218	10.009
1000	19.000	39.914	27.546	12.328	-59.557	-39.170	8.560
1000	19.000	39.914	27.586	12.328	-59.557	-39.170	8.560
1100	19.209	41.735	28.791	14.238	-59.375	-37.139	7.378
1200	19.418	43.416	29.941	16.170	-59.195	-35.127	6.397
1300	19.628	44.978	31.038	18.122	-59.021	-33.128	5.569
1400	19.837	46.440	32.087	20.095	-58.851	-31.141	4.861
1500	20.046	47.816	33.090	22.090	-58.680	-29.169	4.250
1600	20.255	49.117	34.051	24.105	-58.511	-27.206	3.716
1700	20.464	50.351	34.974	26.141	-58.346	-25.257	3.247
1800	20.674	51.526	35.861	28.197	-58.182	-23.315	2.831
1900	20.883	52.650	36.715	30.275	-58.019	-21.380	2.459
2000	21.092	53.726	37.539	32.374	-57.855	-19.455	2.126
2100	21.301	54.760	38.335	34.494	-57.691	-17.540	1.825
2200	21.510	55.756	39.104	36.634	-57.528	-15.634	1.541
2300	21.720	56.717	39.849	38.796	-57.366	-13.731	1.278
2400	21.929	57.646	40.571	40.978	-57.202	-11.840	1.038
2500	22.138	58.545	41.273	43.182	-57.037	-9.951	0.810
2600	22.347	59.417	41.954	45.406	-56.873	-8.072	0.679
2673	22.500	60.038	42.439	47.043	-56.753	-6.701	0.548

31 December 1963

HLS

TANTALUM NITRIDE (TaN) (CONDENSED PHASE) gfw 194.958

$$\Delta H_{f,298,15}^0 = -59.95 \text{ kcal gfw}^{-1} \quad S_{298,15}^0 = 12.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3363^\circ\text{K}$$

$$\Delta H_m = 16.0 \text{ kcal gfw}^{-1}$$

$$H_{298,15}^0 - H_0^0 = 1.779 \text{ kcal gfw}^{-1}$$

$$C_p^0 = 7.73 + 7.80 \times 10^{-4} \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^\circ\text{K} \leq T \leq 1000^\circ\text{K}$$

$$C_p^0 = 15.53 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1000^\circ\text{K} \leq T \leq 3363^\circ\text{K}$$

$$C_p^0 = 15.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 3363^\circ\text{K} \leq T \leq 6000^\circ\text{K}$$

Structure

TaN has an hexagonal structure and a limited homogeneity range.

Heat of Formation

Data of Mah and Gellert¹ slightly altered.

Heat-Capacity and Entropy

Low-temperature data estimated. Data from 298.15° to 1000°K use Kelley² equation which is extrapolated above 773°K. Data above 1000°K estimated.

Melting and Vaporization

Heat of melting estimated.

References

1. Mah, A. D. and N. L. Gellert, J. Am. Chem. Soc. 78, 3261 (1956).
2. Kelley, K. K., U. S. Bur. Mines, Bull. 584 (1960).

TANTALUM NITRIDE (TaN) (CONDENSED PHASE) GFW = 194.958

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	S_T	$-(F_T^0 - H_{298}^0)/T$	$H_T - H_{298}$	ΔH_f	ΔF_f	$\log K_p$
298.15	± 0.200	± 1.000	± 1.000	± 0.000	± 4.000		
1000	± 0.200	± 1.242	± 1.102	± 0.140			
1000	± 1.000	± 1.242	± 1.102	± 0.140			
2000	± 1.000	± 1.935	± 1.365	± 1.140			
2000	± 2.000	± 1.935	± 1.365	± 1.140			
3000	± 2.000	± 2.746	± 1.699	± 3.140			
3363	± 2.000	± 2.975	± 1.825	± 3.866			
3363	± 2.000	± 4.461	± 1.825	± 8.866			
4000	± 2.000	± 4.808	± 2.273	± 10.140			
5000	± 2.000	± 5.255	± 2.826	± 12.140			
6000	± 2.000	± 5.619	± 3.262	± 14.140			

TABLE 168

DITANTALUM NITRIDE.

CONDENSED PHASE

 NTa_2

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ia from 0° to 3270°K , Liquid Ia from 3270° to 5706°K , Gaseous Ia from 5706° to 6000°K , Gaseous N_2 , Solid Ia_3N from 0° to 3000°K , Liquid Ia_3N from 3000° to 6000°K

[illegible]

DITANTALUM NITRIDE(Ta₂N) (CONDENSED PHASE) gfw = 375.908

$\Delta H_{298.15}^0 = -64.6 \text{ kcal gfw}^{-1}$ $S_{298.15}^0 = 22.0 \text{ cal degK}^{-1} \text{ gfw}^{-1}$

$T_m = 3000^\circ\text{K}$ $\Delta H_m = 22.0 \text{ kcal gfw}^{-1}$

$H_{298.15}^0 - H_0^0 = 3.163 \text{ kcal gfw}^{-1}$

$C_p^0 = 16.845 + 0.0042193T - 1.6868 \times 10^{-5}T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1}$ $298.15^\circ\text{K} \leq T \leq 3000^\circ\text{K}$

$C_p^0 = 22.5 \text{ cal degK}^{-1} \text{ gfw}^{-1}$ $3000^\circ\text{K} \leq T \leq 6000^\circ\text{K}$

Structure

Ta₂N has an hexagonal structure and a variable homogeneity range.

Heat of Formation

Calorimetric value of Mah¹ used.

Heat Capacity and Entropy

Low-temperature data estimated. High-temperature data reported by Pears et al² recomputed assuming Ta₂N rather than TaN. See volume 1, this work (section IVB27. 3. 2) for details.

Melting and Vaporization

Heat of fusion estimated.

References

1. Mah, A. D., J. Am. Chem. Soc. 80, 3872 (1958).
2. Pears, C. D., et al, ASD TDR 62-765 (January 1963).

DITANTALUM NITRIDE (Ta₂N) (CONDENSED PHASE) GFW = 375.908

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			kcal gfw			log K _p
	C _p ⁰	S _T ⁰	-(F _T - H ₂₉₈ ⁰)/T	H _T ⁰ - H ₂₉₈ ⁰	ΔH _T ⁰	ΔF _T ⁰	
298.15	± 1.000	± 2.000	± 2.000	± 0.000			
1000	± 1.000	± 3.210	± 2.508	± 0.702			
1000	± 2.000	± 3.210	± 2.508	± 0.702			
2000	± 2.000	± 4.596	± 3.246	± 2.702			
3000	± 2.000	± 5.407	± 3.840	± 4.702			
3000	± 3.000	± 7.074	± 3.840	± 9.702			
4000	± 3.000	± 7.937	± 4.762	± 12.702			
5000	± 3.000	± 8.607	± 5.466	± 15.702			
6000	± 3.000	± 9.153	± 6.037	± 18.702			

TABLE 169

TITANIUM NITRIDE

CONDENSED PHASE

NTI

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
 Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K,
 Gaseous N₂, Solid TiN from 0° to 3223°K, Liquid TiN from
 3223° to 6000°K

T, °K	C_p	C_T	$(H_T^\circ - H_{298}^\circ)/T$	$(H_T^\circ - H_{298}^\circ)$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.310	-79.874	-79.874	INFINITE
298.15	8.860	7.240	7.240	0.000	-80.750	-73.900	54.167
300	8.903	7.255	7.240	0.015	-80.751	-73.857	53.802
400	10.436	10.076	7.512	0.294	-80.742	-71.558	39.095
500	11.196	12.514	8.557	2.079	-80.657	-69.270	30.277
600	11.652	14.575	9.227	3.223	-80.543	-67.003	24.405
700	11.964	16.420	10.128	4.405	-80.418	-64.757	20.217
800	12.199	18.033	11.201	5.613	-80.292	-62.528	17.081
900	12.391	19.467	11.878	6.843	-80.167	-60.314	14.646
1000	12.554	20.796	12.705	8.090	-80.047	-58.115	12.700
1100	12.699	21.999	13.496	9.353	-79.932	-55.928	11.111
1150	12.774	22.621	13.916	10.054	-79.870	-54.728	10.355
1155	12.774	22.621	13.916	10.054	-79.870	-54.728	10.355
1200	12.832	23.110	14.217	10.640	-80.771	-53.713	9.782
1300	12.957	24.142	14.773	11.219	-80.666	-51.463	8.651
1400	13.075	25.107	15.663	13.221	-80.564	-49.220	7.683
1500	13.189	26.013	16.323	14.534	-80.476	-46.986	6.845
1600	13.298	26.867	16.756	15.859	-80.370	-44.757	6.113
1700	13.406	27.677	17.563	17.194	-80.277	-42.536	5.468
1800	13.511	28.446	18.166	18.540	-80.186	-40.316	4.895
1900	13.614	29.179	18.708	19.896	-80.098	-38.104	4.383
1950	13.655	29.544	18.981	20.578	-80.074	-36.799	4.147
2000	13.716	29.860	19.243	21.267	-80.046	-35.551	3.912
2100	13.817	30.532	19.771	22.639	-80.539	-34.410	3.477
2200	13.917	31.157	20.276	24.027	-81.385	-34.327	3.410
2300	14.016	31.810	20.764	25.477	-81.223	-28.649	2.722
2400	14.113	32.496	21.238	26.829	-81.052	-26.282	2.393
2500	14.213	33.215	21.696	28.247	-81.873	-23.919	2.091
2600	14.310	33.956	22.147	29.672	-82.686	-21.565	1.813
2700	14.407	34.706	22.574	31.107	-82.488	-19.217	1.555
2800	14.504	35.471	22.995	32.553	-82.282	-16.876	1.317
2900	14.601	36.253	23.405	34.008	-82.069	-14.544	1.096
3000	14.697	37.022	23.806	35.473	-81.846	-12.221	0.890
3100	14.793	37.787	24.194	36.948	-81.613	-9.907	0.698
3200	14.888	38.543	24.574	38.432	-81.377	-7.595	0.519
3300	14.983	39.290	24.946	39.917	-81.137	-5.286	0.479
3400	15.077	40.022	25.303	41.406	-80.891	-2.986	0.479
3500	15.170	40.742	25.643	42.900	-80.641	-0.690	0.374
3600	15.262	41.450	25.961	44.400	-80.386	1.618	0.246
3700	15.353	42.143	26.263	45.906	-80.126	3.914	0.126
3800	15.443	42.823	26.543	47.420	-79.861	6.208	0.069
3900	15.532	43.490	26.806	48.940	-79.591	8.500	0.069
4000	15.620	44.143	27.056	50.466	-79.316	10.791	0.069
4100	15.707	44.783	27.294	51.998	-79.036	13.081	0.069
4200	15.793	45.410	27.519	53.536	-78.751	15.371	0.069
4300	15.878	46.023	27.733	55.080	-78.461	17.661	0.069
4400	15.962	46.623	27.933	56.630	-78.166	19.951	0.069
4500	16.045	47.210	28.120	58.186	-77.866	22.241	0.069
4600	16.127	47.783	28.294	59.748	-77.561	24.531	0.069
4700	16.208	48.343	28.456	61.316	-77.251	26.821	0.069
4800	16.288	48.890	28.606	62.890	-76.936	29.111	0.069
4900	16.367	49.423	28.743	64.470	-76.616	31.401	0.069
5000	16.445	49.943	28.866	66.056	-76.291	33.691	0.069
5100	16.522	50.450	28.976	67.648	-75.961	35.981	0.069
5200	16.598	50.943	29.073	69.246	-75.626	38.271	0.069
5300	16.673	51.423	29.156	70.850	-75.286	40.561	0.069
5400	16.747	51.890	29.226	72.460	-74.941	42.851	0.069
5500	16.820	52.343	29.283	74.076	-74.591	45.141	0.069
5600	16.892	52.783	29.326	75.698	-74.236	47.431	0.069
5700	16.963	53.210	29.356	77.326	-73.876	49.721	0.069
5800	17.033	53.623	29.373	78.960	-73.511	52.011	0.069
5900	17.102	54.023	29.376	80.600	-73.141	54.301	0.069
6000	17.170	54.410	29.366	82.246	-72.766	56.591	0.069

31 December 1963

HLS

TITANIUM NITRIDE (TiN)**(CONDENSED PHASE)**

gfw = 61.908

$$\Delta H_{f,298.15}^{\circ} = -80.750 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 7.24 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3223^{\circ}\text{K}$$

$$\Delta H_m = 15.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.310 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.91 + 0.94 \times 10^{-3}T - 2.96 \times 10^{-5}T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3223^{\circ}\text{K}$$

$$C_p^{\circ} = 16.0 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$3223^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

TiN has a cubic structure (NaCl type) with a wide homogeneity range.

Heat of Formation

Combustion data of Humphrey¹ modified to be consistent with present compilation.

Heat Capacity and Entropy

Low-temperature data from Shomate.² High-temperature data of Naylor³ valid to 1738°K extrapolated to melting point. Data above melting point estimated.

Melting and Vaporization

Heat of fusion estimated.

References

1. Humphrey, G. L., J. Am. Chem. Soc. 73, 2261 (1951).
2. Shomate, C. H., J. Am. Chem. Soc. 68, 310 (1946).
3. Naylor, B. F., J. Am. Chem. Soc. 68, 370 (1946).

TABLE 170

ZIRCONIUM NITRIDE

CONDENSED PHASE

NZr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$:
 Solid Zr from 0° to 2125°K, Liquid Zr from 2125° to 4644°K,
 Gaseous Zr from 4644° to 6000°K; Gaseous N₂:
 Solid ZrN from 0° to 3253°K,
 Liquid ZrN from 3253° to 6000°K.

T, °K	C_p	S_T	$H_T^\circ - H_{298}^\circ/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.575	-86.526	-86.526	INFINITE
298.15	9.666	9.290	9.290	0.000	-87.300	-80.477	58.988
300	9.693	9.350	9.290	0.018	-87.299	-80.434	58.594
400	10.697	12.293	9.685	1.043	-87.254	-78.151	47.698
500	11.252	14.744	10.459	2.143	-87.178	-75.884	33.167
600	11.630	16.831	11.351	3.288	-87.091	-73.633	26.820
700	11.925	18.547	12.266	4.466	-86.999	-71.397	22.290
800	12.175	20.216	13.166	5.672	-86.907	-69.175	18.897
900	12.400	21.703	14.036	6.900	-86.818	-66.964	16.260
1000	12.608	23.020	14.869	8.151	-86.730	-64.762	14.153
1100	12.806	24.231	15.666	9.422	-86.645	-62.570	12.431
1135	12.873	24.634	15.737	9.871	-86.615	-61.805	11.900
1135	12.873	24.634	15.737	9.871	-87.530	-61.805	11.900
1200	12.997	25.354	16.427	10.712	-87.464	-60.333	10.988
1300	13.182	26.402	17.155	12.021	-87.351	-58.077	9.763
1400	13.364	27.385	17.851	13.348	-87.244	-55.830	8.715
1500	13.544	28.313	18.518	14.694	-87.083	-53.593	7.808
1600	13.721	29.143	19.158	16.057	-86.928	-51.365	7.016
1700	13.896	30.030	19.773	17.438	-86.758	-49.147	6.318
1800	14.071	30.827	20.365	18.836	-86.574	-46.939	5.699
1900	14.244	31.545	20.936	20.252	-86.375	-44.743	5.146
2000	14.417	32.230	21.487	21.685	-86.161	-42.557	4.650
2100	14.589	33.037	22.021	23.135	-85.931	-40.384	4.203
2125	14.632	33.210	22.151	23.501	-85.870	-40.337	4.148
2125	14.632	33.210	22.151	23.501	-90.770	-40.337	4.148
2200	14.760	33.720	22.537	24.603	-90.593	-41.345	4.107
2300	14.941	34.380	23.038	25.087	-90.343	-35.664	3.389
2400	15.122	35.019	23.524	25.589	-90.077	-33.293	3.032
2500	15.272	35.619	23.996	26.108	-89.795	-30.931	2.704
2600	15.443	36.241	24.455	30.644	-89.497	-28.580	2.402
2700	15.612	36.827	24.903	32.196	-89.184	-26.248	2.124
2800	15.782	37.398	25.339	33.766	-88.854	-23.922	1.867
2900	15.952	37.955	25.764	35.353	-88.509	-21.605	1.628
3000	16.121	38.499	26.180	36.956	-88.148	-19.308	1.407
3100	16.290	39.030	26.586	38.577	-87.771	-17.018	1.200
3200	16.459	39.550	26.983	40.214	-87.374	-14.743	1.007
3253	16.549	39.821	27.190	41.089	-87.161	-13.543	0.910
3253	16.549	39.821	27.190	41.089	-67.161	-13.543	0.910
3300	16.600	40.197	27.459	41.841	-66.993	-12.768	0.846
3400	16.700	40.776	28.017	43.441	-66.638	-11.130	0.715
3500	16.800	41.340	28.557	45.041	-66.284	-9.502	0.593
3600	16.900	41.891	29.079	46.641	-65.930	-7.884	0.479
3700	16.900	42.429	29.586	48.241	-65.577	-6.277	0.371
3800	16.900	42.956	30.077	49.841	-65.224	-4.682	0.269
3900	16.900	43.471	30.553	51.441	-64.872	-3.087	0.173
4000	16.900	43.977	31.016	53.041	-64.521	-1.508	0.082
4100	16.900	44.472	31.466	54.641	-64.169	0.063	-0.003
4200	16.900	44.957	31.905	56.241	-63.818	1.620	-0.084
4300	16.900	45.434	32.331	57.841	-63.468	3.178	-0.162
4400	16.900	45.901	32.747	59.441	-63.118	4.722	-0.235
4500	16.900	46.361	33.152	61.041	-62.769	6.262	-0.304
4600	16.900	46.813	33.547	62.641	-62.420	7.793	-0.370
4644.05	16.900	47.265	33.918	64.241	-62.065	9.317	-0.438
4644.05	16.900	47.265	33.918	64.241	-197.719	9.317	-0.438
4700	16.900	47.717	34.283	65.841	-197.379	10.949	-0.509
4800	16.900	48.164	34.631	67.441	-197.032	12.582	-0.580
4900	16.900	48.614	34.978	69.041	-196.681	14.215	-0.651
5000	16.900	49.067	35.319	70.641	-196.324	15.848	-0.722
5100	16.900	49.516	35.651	72.241	-195.963	17.481	-0.793
5200	16.900	49.964	35.976	73.841	-195.603	19.114	-0.864
5300	16.900	50.414	36.301	75.441	-195.243	20.747	-0.935
5400	16.900	50.864	36.628	77.041	-194.883	22.380	-1.006
5500	16.900	51.314	36.953	78.641	-194.523	24.013	-1.077
5600	16.900	51.764	37.278	80.241	-194.163	25.646	-1.148
5700	16.900	52.214	37.603	81.841	-193.803	27.279	-1.219
5800	16.900	52.664	37.928	83.441	-193.443	28.912	-1.290
5900	16.900	53.114	38.253	85.041	-193.083	30.545	-1.361
6000	16.900	53.564	38.578	86.641	-192.723	32.178	-1.432

31 December 1963

HLS

ZIRCONIUM NITRIDE (ZrN) (CONDENSED PHASE) gfw - 105.228

$$\Delta H_{f298.15}^{\circ} = -87.3 \text{ kcal gfw}^{-1} \quad S_{298.15}^{\circ} = 9.29 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3253^{\circ}\text{K}$$

$$\Delta H_m = 20.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.575 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.10 + 1.68 \times 10^{-3}T - 1.72 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3253^{\circ}\text{K}$$

$$C_p^{\circ} = 16.0 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 3253^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

ZrN has a cubic structure isotypic with NaCl. It has a fairly wide homogeneity range.

Heat of Formation

Based on the work of Mah and Gellert,¹ but in agreement with Neumann et al² and Smagina et al.³

Heat Capacity and Entropy

The low-temperature data of Todd⁴ used. High-temperature data of Coughlin and King⁵ extrapolated to melting point.

Melting and Vaporization

Melting temperature by Agte and Moers.⁶

References

1. Mah, A. D. and N. L. Gellert, J. Am. Chem. Soc. 78, 3261 (1956).
2. Neumann, B. et al, Z. Anorg. Chem. 218, 379 (1934).
3. Smagina, E. I. et al, Dokl. Akad. Nauk SSSR 115, 354 (1957).
4. Todd, S. S., J. Am. Chem. Soc. 72, 2914 (1950).
5. Coughlin, J. P. and E. G. King, J. Am. Chem. Soc. 72, 2262 (1950).
6. Agte, C. and K. Moers, Z. Anorg. Chem. 198, 239 (1931).

TABLE 171

NITROGEN

REFERENCE STATE

N₂Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$:
Gaseous Diatomic N₂ from 0° to 6000°K.

T, °K	C_p	C_p	$(-RT \ln H_{298}^\circ)/T$	$H_f^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-7.072			
298.15	6.961	45.771	45.771	0.000			
300	6.961	45.814	45.771	0.013			
400	6.991	47.820	46.045	0.710			
500	7.070	49.388	46.562	1.413			
600	7.197	50.687	47.144	2.126			
700	7.351	51.808	47.732	2.853			
800	7.513	52.800	48.305	3.596			
900	7.670	53.695	48.855	4.356			
1000	7.815	54.510	49.380	5.130			
1100	7.945	55.261	49.881	5.918			
1200	8.061	55.958	50.359	6.719			
1300	8.162	56.607	50.815	7.530			
1400	8.250	57.215	51.251	8.351			
1500	8.328	57.787	51.667	9.180			
1600	8.396	58.327	52.067	10.016			
1700	8.456	58.838	52.450	10.858			
1800	8.509	59.322	52.819	11.707			
1900	8.555	59.784	53.173	12.560			
2000	8.597	60.224	53.515	13.418			
2100	8.635	60.644	53.844	14.279			
2200	8.668	61.047	54.163	15.144			
2300	8.698	61.433	54.471	16.013			
2400	8.726	61.803	54.768	16.884			
2500	8.751	62.160	55.057	17.758			
2600	8.774	62.504	55.337	18.634			
2700	8.795	62.835	55.608	19.513			
2800	8.814	63.156	55.872	20.393			
2900	8.832	63.465	56.129	21.276			
3000	8.849	63.765	56.378	22.160			
3100	8.865	64.055	56.621	23.045			
3200	8.879	64.337	56.858	23.933			
3300	8.893	64.610	57.089	24.821			
3400	8.906	64.876	57.314	25.711			
3500	8.918	65.134	57.534	26.602			
3600	8.930	65.386	57.748	27.495			
3700	8.941	65.631	57.958	28.388			
3800	8.951	65.869	58.163	29.283			
3900	8.961	66.102	58.364	30.178			
4000	8.971	66.329	58.560	31.075			
4100	8.980	66.551	58.752	31.973			
4200	8.989	66.767	58.941	32.871			
4300	8.998	66.979	59.125	33.770			
4400	9.006	67.186	59.306	34.671			
4500	9.014	67.388	59.483	35.572			
4600	9.022	67.587	59.657	36.474			
4700	9.030	67.781	59.828	37.376			
4800	9.038	67.971	59.996	38.280			
4900	9.045	68.157	60.161	39.184			
5000	9.053	68.340	60.322	40.089			
5100	9.060	68.520	60.481	40.994			
5200	9.068	68.696	60.638	41.901			
5300	9.075	68.868	60.792	42.808			
5400	9.083	69.038	60.943	43.716			
5500	9.090	69.205	61.091	44.624			
5600	9.098	69.369	61.238	45.534			
5700	9.105	69.530	61.382	46.444			
5800	9.113	69.689	61.524	47.355			
5900	9.122	69.844	61.664	48.267			
6000	9.130	69.998	61.801	49.179			

May 1962

RCF

NITROGEN (N₂)

(REFERENCE STATE)

gfw = 28.016

$$\Delta H_{f0}^{\circ} = 0.0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0.0 \text{ kcal gfw}^{-1}$$

Ground State Configuration - $1\Sigma_g^+$

$$S_{298.15}^{\circ} = 45.771 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.072 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	a_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X $1\Sigma_g^+$	1	0.0	2357.93	14.186	-0.0124	1.9981	0.01709	-4.6	6
A $3\Sigma_u^+$	3	49757.2	1460.19	13.888	-0.025	1.440	0.013	-	5.6
B $3\Pi_g$	6	59314.2	1733.89	14.47	-	1.6376	0.0184	-	5.8

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Calculated on diatomic gas-computer program using above spectroscopic constants.

Reference

1. Barriault, R. J., et al, ASD TR 61-620 (May 1962), Pt. 1.

NITROGEN (N₂)

(REFERENCE STATE)

GFW = 28.016

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	$\log K_p$
298.15	±0.000	±0.002	±0.002	±0.000			
1000	±0.000	±0.003	±0.002	±0.000			
2000	±0.000	±0.003	±0.003	±0.001			
3000	±0.000	±0.004	±0.003	±0.001			
4000	±0.000	±0.004	±0.003	±0.001			
5000	±0.000	±0.004	±0.003	±0.001			
6000	±0.000	±0.004	±0.003	±0.001			

TABLE 172

SILICON NITRIDE

CONDENSED PHASE

 N_4Si_3

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$:
 Solid Si from 0° to 1690°K, Liquid Si from 1690° to 3566°K,
 Gaseous Si from 3566° to 6000°K; Gaseous N_2 ;
 Solid Si_3N_4 from 0° to 4000°K.

T, °K	c_p	c_p	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-5.598	-175.147	-175.147	INFINITE
298.15	30.900	25.600	25.600	0.000	-176.000	-152.288	111.624
300	30.941	25.791	25.601	0.057	-175.996	-152.141	110.829
400	32.544	34.935	26.836	3.239	-175.732	-144.228	78.799
500	33.542	42.311	29.217	6.547	-175.477	-136.383	59.610
600	34.304	48.496	31.929	9.940	-175.232	-128.587	46.836
700	34.953	53.834	34.685	13.404	-174.995	-120.832	37.724
800	35.542	58.540	37.379	16.929	-174.771	-113.111	30.899
900	36.097	62.758	39.968	20.511	-174.560	-105.416	25.597
1000	36.629	66.589	42.442	24.147	-174.359	-97.743	21.361
1100	37.148	70.105	44.799	27.836	-174.163	-90.091	17.899
1200	37.657	73.359	47.045	31.577	-173.971	-82.458	15.017
1300	38.160	76.493	49.187	35.368	-173.776	-74.838	12.581
1400	38.657	79.239	51.233	39.209	-173.578	-67.234	10.495
1500	39.151	81.923	53.191	43.099	-173.377	-59.647	8.690
1600	39.642	84.466	55.066	47.039	-173.164	-52.069	7.112
1690	40.083	86.647	56.691	50.626	-172.965	-45.268	5.854
1690	40.083	86.647	56.691	50.626	-208.815	-45.268	5.854
1700	40.131	86.884	56.868	51.027	-208.782	-44.299	5.695
1800	40.619	89.191	58.600	55.065	-208.558	-36.626	4.204
1900	41.105	91.400	60.268	59.151	-208.311	-24.971	2.872
2000	41.590	93.521	61.878	63.286	-208.043	-15.328	1.675
2100	42.074	95.562	63.434	67.469	-207.727	-5.703	0.593
2200	42.557	97.531	64.939	71.701	-207.373	-9.288	0.923
2300	43.040	99.433	66.398	75.980	-206.977	13.504	-1.283
2400	43.522	101.275	67.813	80.308	-206.539	23.078	-2.101
2500	44.004	103.061	69.187	84.685	-206.055	32.617	-2.853
2600	44.485	104.797	70.524	89.109	-205.531	42.176	-3.545
2700	44.966	106.484	71.824	93.582	-204.961	51.688	-4.184
2800	45.447	108.128	73.092	98.103	-204.348	61.182	-4.775
2900	45.929	109.732	74.328	102.671	-203.691	70.657	-5.325
3000	46.408	111.297	75.534	107.288	-202.990	80.107	-5.836
3100	46.889	112.826	76.712	111.953	-202.240	89.530	-6.312
3200	47.369	114.323	77.864	116.666	-201.451	98.931	-6.756
3300	47.849	115.788	78.992	121.427	-200.621	108.305	-7.172
3400	48.329	117.223	80.095	126.236	-199.753	117.658	-7.563
3500	48.809	118.631	81.176	131.092	-198.853	126.981	-7.929
3566.77	49.124	119.543	81.875	134.313	-198.164	133.092	-8.157
3566.77	49.124	119.543	81.875	134.313	-477.649	133.092	-8.157
3600	49.288	120.013	82.236	135.997	-472.141	138.903	-8.432
3700	49.768	121.370	83.275	140.950	-470.627	155.860	-9.206
3800	50.247	122.703	84.295	145.951	-469.072	172.172	-9.936
3900	50.727	124.015	85.297	151.000	-467.469	189.637	-10.626
4000	51.206	124.405	86.281	156.026	-465.820	206.472	-11.281

SILICON NITRIDE (Si_3N_4)

(CONDENSED PHASE)

gfw = 140.302

$$\Delta H_f^0_{298} = -176.0 \text{ kcal gfw}^{-1}$$

$$S^0_{298.15} = 25.6 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_{\text{sublimation}} = 2170^\circ\text{K}$$

$$H^0_{298.15} - H^0_0 = 5.598 \text{ kcal gfw}^{-1}$$

$$C_p^0 = 32.074 + 0.0047867T - 0.23122 \times 10^{-6} T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15^\circ\text{K} \leq T \leq 4000^\circ\text{K}$$

Structure

α - Si_3N_4 is probably hexagonal as is β - Si_3N_4 .

Heat of Formation

Based on dissociation-pressure measurements of Pehlke and Elliott.¹

Heat Capacity and Entropy

Low-and high-temperature data estimated by Pehlke and Elliott.¹ An equation derived based on their data and extrapolated. Experimental enthalpies of Neel et al² somewhat larger than the estimated values used here.

Melting and Vaporization

Si_3N_4 considered to sublime rather than melt.

References

1. Pehlke, R. D. and J. F. Elliott, Trans. AIME 215, 781 (1959).
2. Neel, D. S. et al, WAD TR 60-924 (1962).

SILICON NITRIDE (Si_3N_4)

(CONDENSED PHASE)

GFW = 140.302

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p^0	S_T^0	$-(H_T^0 - H_{298}^0)/T$	$H_T^0 - H_{298}^0$	ΔH_f^0	ΔH_f^0	log K _p
298.15	± 5.000	± 4.000	± 4.000	± 0.000	± 6.000		
500	± 5.000	± 6.585	± 4.567	± 1.009			
1000	± 5.000	± 10.051	± 6.542	± 3.509			
1500	± 5.000	± 12.078	± 8.072	± 6.009			
1690	± 5.000	± 12.674	± 8.557	± 6.959			
2000	± 5.000	± 13.517	± 9.262	± 8.509			
2500	± 5.000	± 14.632	± 10.229	± 11.009			
3000	± 5.000	± 15.544	± 11.041	± 13.509			
3500	± 5.000	± 16.315	± 11.741	± 16.009			
3565.77	± 5.000	± 16.408	± 11.826	± 16.338			
4000	± 5.000	± 16.982	± 12.355	± 18.509			

TABLE 173

NIOBIUM

REFERENCE STATE

Nb

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Nb from 0° to 2741°K,
Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K.

T, °K	ϵ_p°	σ_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.264			
298.15	5.946	9.000	9.000	0.000			
300	5.948	9.037	9.000	0.011			
400	6.044	10.761	9.235	0.611			
500	6.140	12.120	9.680	1.220			
600	6.236	13.248	10.184	1.839			
700	6.332	14.216	10.692	2.467			
800	6.428	15.068	11.187	3.105			
900	6.524	15.831	11.661	3.753			
1000	6.620	16.523	12.113	4.410			
1100	6.716	17.159	12.544	5.077			
1200	6.812	17.747	12.953	5.753			
1300	6.908	18.296	13.343	6.439			
1400	7.004	18.812	13.716	7.135			
1500	7.100	19.298	14.072	7.840			
1600	7.196	19.759	14.413	8.555			
1700	7.292	20.199	14.740	9.279			
1800	7.388	20.618	15.055	10.013			
1900	7.484	21.020	15.359	10.757			
2000	7.580	21.406	15.652	11.510			
2100	7.676	21.779	15.935	12.273			
2200	7.772	22.138	16.208	13.045			
2300	7.868	22.486	16.474	13.827			
2400	7.964	22.822	16.731	14.619			
2500	8.060	23.149	16.982	15.420			
2600	8.156	23.467	17.225	16.231			
2700	8.252	23.777	17.462	17.051			
2741	8.291	23.902	17.557	17.390			
2741	8.000	26.237	17.557	23.790			
2800	8.000	26.407	17.742	24.262			
2900	8.000	26.688	18.046	25.062			
3000	8.000	26.959	18.338	25.862			
3100	8.000	27.221	18.621	26.662			
3200	8.000	27.475	18.893	27.462			
3300	8.000	27.721	19.157	28.262			
3400	8.000	27.960	19.413	29.062			
3500	8.000	28.192	19.660	29.862			
3600	8.000	28.418	19.900	30.662			
3700	8.000	28.647	20.133	31.462			
3800	8.000	28.850	20.360	32.262			
3900	8.000	29.058	20.580	33.062			
4000	8.000	29.260	20.795	33.862			
4100	8.000	29.458	21.004	34.662			
4200	8.000	29.651	21.207	35.462			
4300	8.000	29.839	21.406	36.262			
4400	8.000	30.023	21.600	37.062			
4500	8.000	30.203	21.789	37.862			
4600	8.000	30.379	21.974	38.662			
4700	8.000	30.551	22.154	39.462			
4800	8.000	30.719	22.331	40.262			
4900	8.000	30.884	22.504	41.062			
5000	8.000	31.046	22.673	41.862			
5031.58	8.000	31.082	22.713	42.115			
5031.58	8.600	61.393	22.713	204.688			
5100	8.640	61.510	23.260	205.277			
5200	8.695	61.678	24.036	206.144			
5300	8.749	61.844	24.785	207.016			
5400	8.800	64.008	25.510	207.893			
5500	8.848	64.170	26.211	208.776			
5600	8.895	64.330	26.890	209.663			
5700	8.939	64.488	27.548	210.555			
5800	8.981	64.644	28.187	211.451			
5900	9.021	64.798	28.806	212.351			
6000	9.059	64.950	29.407	213.255			

15 March 1963

HLS

0°K to 2741°K
2741°K to 5032°K
5032°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 171.836 \text{ Kcal gfw}^{-1}$$

$$T_m = 2741^{\circ}\text{K}$$

$$T_b = 5031.58^{\circ}\text{K}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.264 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.66 + 0.96 \times 10^{-3} T \text{ cal deg}^{-1} \text{ gfw}^{-1} \text{ for } 298.15^{\circ}\text{K} \leq T \leq 2741^{\circ}\text{K}$$

$$C_p^{\circ} = 8.00 \pm 2.0 \text{ cal deg}^{-1} \text{ gfw}^{-1} \text{ for liquid } (2741^{\circ}\text{K} \leq T \leq 5032^{\circ}\text{K}) \text{ (Estd.)}$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$S_{298.15}^{\circ} = 9.0 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$\Delta H_m = 6.400 \pm 1.000 \text{ Kcal gfw}^{-1} \text{ (Estd.)}$$

$$\Delta H_v = 162.573 \text{ Kcal gfw}^{-1}$$

Structure

Solid has a B. C. C. type structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Entropy at 298.15°K from Kelley and King ¹ High-temperature data of Kelley ² was extrapolated.

Melting

Temperature of fusion from Schofield ³ Heat of fusion estimated by Kelley ² and by Stull and Sinke ⁴

Heat of Sublimation

Data of Speiser et al ⁵ was used.

References

1. Kelley, K. K. and E. G. King, U. S. Bur. Mines, Bull. 592 (1961)
2. Kelley, K. K., U. S. Bur. Mines, Bull. 584 (1960).
3. Schofield, T. H., J. Inst. Metals 85, 372 (1957).
4. Stull, D. R. and G. C. Sinke, Thermodynamic Properties of the Elements (1956).
5. Speiser, R., P. Blackburn and H. L. Johnston, J. Electrochem Soc. 106, 52-3 (1959).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.100	±0.400	±0.400	±0.000			
1000	±0.300	±0.660	±0.489	±0.170			
2000	±0.500	±0.925	±0.640	±0.570			
2741	±1.000	±1.129	±0.742	±1.061			
2741	±2.000	±1.494	±0.742	±2.061			
3000	±2.000	±1.674	±0.814	±2.579			
4000	±2.000	±2.250	±1.105	±4.579			
5000	±2.000	±2.696	±1.380	±6.579			
5031.58	±2.000	±2.708	±1.388	±6.642			

TABLE 174

MOBIUM

IDEAL MONATOMIC GAS

Nb

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Nb from 0° to 2741°K.
Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.997	171.103	171.103	INFINITE
298.15	7.208	44.492	44.492	0.000	171.836	161.254	-118.197
300	7.208	44.537	44.492	0.013	171.838	161.188	-117.420
400	7.086	46.597	44.774	0.729	171.954	157.620	-86.116
500	6.893	48.157	45.301	1.428	172.044	154.026	-67.321
600	6.704	49.397	45.884	2.108	172.105	150.416	-54.786
700	6.541	50.418	46.461	2.770	172.139	146.798	-45.830
800	6.402	51.282	47.011	3.417	172.148	143.177	-39.112
900	6.285	52.029	47.528	4.051	172.134	139.556	-33.887
1000	6.186	52.686	48.012	4.674	172.100	135.937	-29.708
1100	6.103	53.272	48.464	5.289	172.048	132.324	-26.289
1200	6.035	53.800	48.887	5.895	171.978	128.716	-23.441
1300	5.981	54.280	49.283	6.496	171.893	125.114	-21.032
1400	5.941	54.722	49.656	7.092	171.793	121.520	-18.969
1500	5.915	55.131	50.008	7.685	171.681	117.932	-17.182
1600	5.903	55.512	50.340	8.276	171.557	114.353	-15.619
1700	5.904	55.870	50.655	8.866	171.423	110.781	-14.241
1800	5.918	56.208	50.954	9.457	171.280	107.218	-13.017
1900	5.945	56.528	51.239	10.050	171.129	103.664	-11.923
2000	5.984	56.834	51.511	10.646	170.972	100.117	-10.940
2100	6.034	57.127	51.772	11.247	170.810	96.579	-10.051
2200	6.094	57.409	52.022	11.853	170.644	93.046	-9.243
2300	6.164	57.682	52.262	12.466	170.475	89.524	-8.506
2400	6.242	57.946	52.493	13.086	170.303	86.007	-7.832
2500	6.328	58.202	52.716	13.715	170.131	82.500	-7.212
2600	6.419	58.452	52.932	14.352	169.957	78.997	-6.640
2700	6.516	58.696	53.141	14.999	169.784	75.502	-6.111
2741	6.556	58.795	53.225	15.267	169.713	74.070	-5.906
2741	6.556	58.795	53.225	15.267	163.313	74.070	-5.906
2800	6.616	58.935	53.344	15.655	163.229	72.150	-5.631
2900	6.719	59.169	53.541	16.322	163.096	68.901	-5.192
3000	6.825	59.399	53.732	16.999	162.973	65.653	-4.783
3100	6.931	59.624	53.919	17.687	162.861	62.413	-4.400
3200	7.038	59.846	54.100	18.385	162.759	59.172	-4.041
3300	7.144	60.064	54.278	19.095	162.669	55.937	-3.704
3400	7.250	60.279	54.451	19.814	162.588	52.706	-3.388
3500	7.354	60.491	54.621	20.543	162.519	49.473	-3.089
3600	7.456	60.699	54.787	21.285	162.459	46.244	-2.807
3700	7.555	60.905	54.949	22.036	162.410	43.016	-2.541
3800	7.652	61.108	55.109	22.796	162.370	39.791	-2.288
3900	7.747	61.308	55.265	23.566	162.340	36.564	-2.049
4000	7.838	61.505	55.419	24.345	162.319	33.341	-1.822
4100	7.926	61.700	55.569	25.133	162.307	30.118	-1.605
4200	8.011	61.892	55.718	25.930	162.304	26.891	-1.399
4300	8.093	62.081	55.863	26.736	162.310	23.669	-1.203
4400	8.172	62.268	56.007	27.549	162.323	20.445	-1.015
4500	8.247	62.453	56.148	28.370	162.344	17.220	-0.836
4600	8.320	62.635	56.287	29.198	162.372	13.995	-0.665
4700	8.390	62.814	56.424	30.034	162.408	10.766	-0.501
4800	8.456	62.992	56.559	30.876	162.450	7.541	-0.343
4900	8.520	63.167	56.692	31.725	162.499	4.314	-0.192
5000	8.581	63.339	56.823	32.580	162.554	1.084	-0.047
5031.58	8.600	63.393	56.864	32.851	162.572	0.000	-0.000
5031.58	8.600	63.393	56.864	32.851			
5100	8.640	63.510	56.953	33.441			
5200	8.695	63.678	57.081	34.308			
5300	8.749	63.844	57.207	35.180			
5400	8.800	64.008	57.331	36.057			
5500	8.848	64.170	57.454	36.940			
5600	8.895	64.330	57.575	37.827			
5700	8.939	64.488	57.695	38.719			
5800	8.981	64.644	57.814	39.615			
5900	9.021	64.798	57.931	40.515			
6000	9.059	64.950	58.046	41.419			

15 March 1963

HLS

$$\Delta H_{f0}^{\circ} = 171.103 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $6D_{3/2}$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.997 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 171.836 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 44.492 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

All energy levels listed by Moore¹

Heat of Formation

Vapor-pressure data of Speiser *et al*² were used.

Heat Capacity and Entropy

Calculated using the monatomic gas program.

References

1. Moore, C. E., Natl. Bur. Standards (U.S.), Circ. 467, Vol. 2 (1952).
2. Speiser, R., P. Blackburn and H. L. Johnston, J. Electrochem. Soc. 106, 52 (1959).

NIOBIUM, MONATOMIC (Nb)

(IDEAL GAS)

GFW = 92.91

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	S_T	$-(F_T - H_{298}^{\circ})/T$	$H_T - H_{298}^{\circ}$	ΔH_f	ΔG_f
298.15	±0.001	±0.002	±0.003	±0.000	±4.000	
1000	±0.000	±0.003	±0.003	±0.000		
2000	±0.000	±0.003	±0.003	±0.001		
3000	±0.001	±0.003	±0.003	±0.001		
4000	±0.002	±0.003	±0.003	±0.002		
5000	±0.002	±0.004	±0.003	±0.004		
5031.58	±0.002	±0.004	±0.003	±0.004		
6000	±0.003	±0.004	±0.003	±0.006		

TABLE 175

NIOBIUM MONOXIDE

CONDENSED PHASE

NbO

Reference State for Calculating ΔH_f° , ΔF_f° , $\log K_p$: Solid Nb from 0° to 2741°K,
 Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K, Gaseous O₂,
 Solid NbO from 0° to 2218°K, Liquid NbO from 2218° to 6000°K.

T, °K	G_f°	H_f°	$(G_f^\circ - H_f^\circ)/T$	$H_f^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.800	-97.198	-97.198	INFINITE
298.15	9.860	12.000	12.000	0.000	-97.700	-91.289	66.913
300	9.875	12.061	12.000	0.018	-97.699	-91.249	66.472
400	10.491	14.994	12.396	1.039	-97.633	-89.108	48.684
500	10.902	17.381	13.162	2.110	-97.537	-86.987	38.020
600	11.232	19.399	14.037	3.217	-97.427	-84.887	30.918
700	11.525	21.153	14.931	4.355	-97.305	-82.807	25.852
800	11.798	22.710	15.808	5.521	-97.176	-80.744	22.057
900	12.058	24.114	16.654	6.714	-97.038	-78.699	19.110
1000	12.312	25.398	17.465	7.933	-96.890	-76.668	16.755
1100	12.560	26.583	18.241	9.176	-96.734	-74.653	14.832
1200	12.806	27.687	18.983	10.445	-96.565	-72.654	13.232
1300	13.049	28.721	19.692	11.737	-96.387	-70.668	11.880
1400	13.290	29.697	20.372	13.054	-96.198	-68.696	10.723
1500	13.530	30.622	21.025	14.395	-95.997	-66.739	9.723
1600	13.769	31.503	21.653	15.760	-95.786	-64.797	8.850
1700	14.008	32.345	22.257	17.149	-95.567	-62.867	8.082
1800	14.246	33.152	22.840	18.562	-95.328	-60.950	7.400
1900	14.483	33.929	23.403	19.998	-95.083	-59.045	6.791
2000	14.720	34.678	23.949	21.459	-94.825	-57.156	6.245
2100	14.957	35.402	24.477	22.943	-94.557	-55.279	5.753
2200	15.194	36.103	24.989	24.450	-94.277	-53.415	5.306
2218	15.236	36.227	25.080	24.724	-94.226	-53.083	5.230
2218	15.000	42.088	25.080	37.724	-81.226	-53.083	5.230
2300	15.000	42.633	25.696	38.954	-81.013	-52.044	4.945
2400	15.000	43.271	26.415	40.454	-80.766	-50.791	4.625
2500	15.000	43.884	27.102	41.954	-80.531	-49.546	4.331
2600	15.000	44.472	27.759	43.454	-80.308	-48.312	4.061
2700	15.000	45.038	28.388	44.954	-80.097	-47.084	3.811
2741	15.000	45.264	28.639	45.569	-80.014	-46.586	3.714
2741	15.000	45.264	28.639	45.569	-86.414	-46.586	3.714
2800	15.000	45.583	28.993	46.454	-86.279	-45.729	3.569
2900	15.000	46.110	29.574	47.954	-86.053	-44.283	3.337
3000	15.000	46.618	30.134	49.454	-85.829	-42.850	3.121
3100	15.000	47.110	30.673	50.954	-85.607	-41.415	2.920
3200	15.000	47.586	31.195	52.454	-85.387	-39.999	2.732
3300	15.000	48.048	31.698	53.954	-85.171	-38.581	2.555
3400	15.000	48.496	32.186	55.454	-84.956	-37.172	2.389
3500	15.000	48.931	32.658	56.954	-84.743	-35.769	2.233
3600	15.000	49.353	33.116	58.454	-84.532	-34.374	2.087
3700	15.000	49.764	33.560	59.954	-84.323	-32.993	1.948
3800	15.000	50.164	33.992	61.454	-84.115	-31.597	1.817
3900	15.000	50.554	34.412	62.954	-83.910	-30.220	1.693
4000	15.000	50.934	34.820	64.454	-83.706	-28.842	1.576
4100	15.000	51.304	35.218	65.954	-83.504	-27.475	1.464
4200	15.000	51.665	35.605	67.454	-83.304	-26.111	1.359
4300	15.000	52.018	35.983	68.954	-83.105	-24.751	1.258
4400	15.000	52.363	36.351	70.454	-82.909	-23.393	1.162
4500	15.000	52.700	36.711	71.954	-82.715	-22.046	1.071
4600	15.000	53.030	37.062	73.454	-82.523	-20.696	0.983
4700	15.000	53.353	37.405	74.954	-82.333	-19.356	0.900
4800	15.000	53.668	37.740	76.454	-82.147	-18.013	0.820
4900	15.000	53.978	38.069	77.954	-81.964	-16.681	0.744
5000	15.000	54.281	38.390	79.454	-81.784	-15.350	0.671
5031.58	15.000	54.375	38.490	79.928	-81.728	-14.993	0.651
5031.58	15.000	54.375	38.490	79.928	-244.301	-14.993	0.651
5100	15.000	54.578	38.704	80.954	-244.224	-11.872	0.509
5200	15.000	54.869	39.012	82.454	-244.121	-7.314	0.307
5300	15.000	55.155	39.314	83.954	-244.029	-2.764	0.114
5400	15.000	55.435	39.610	85.454	-243.950	1.790	-0.072
5500	15.000	55.710	39.901	86.954	-243.886	6.335	-0.252
5600	15.000	55.981	40.185	88.454	-243.836	10.887	-0.425
5700	15.000	56.246	40.465	89.954	-243.804	15.434	-0.592
5800	15.000	56.507	40.739	91.454	-243.792	19.991	-0.753
5900	15.000	56.763	41.009	92.954	-243.803	24.536	-0.909
6000	15.000	57.016	41.273	94.454	-243.839	29.092	-1.060

15 September 1963

HLS

NIObIUM MONOXIDE (NbO) (CONDENSED PHASE) gfw = 108.91

$$\begin{aligned}\Delta H_{f298.15}^{\circ} &= -97.7 \text{ kcal gfw}^{-1} & S_{298.15}^{\circ} &= 12.0 \pm 1.5 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \\ T_m &= 2218^{\circ}\text{K} & \Delta H_m &= 13.0 \pm 4.0 \text{ kcal gfw}^{-1} \\ H_{298.15}^{\circ} - H_0^{\circ} &= 1.800 \text{ kcal gfw}^{-1} \\ C_p^{\circ} &= 10.04 + 2.35 \times 10^{-3}T - 0.783 \times 10^{-5}T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 298.15^{\circ}\text{K} \leq T \leq 2218^{\circ}\text{K} \\ C_p^{\circ} &= 15.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 2218^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}\end{aligned}$$

Structure

NbO has a cubic (NaCl type) lattice with ordered vacancies.

Heat of Formation

An average, rounded value based on two calorimetric and two equilibria determinations. 1-4

Heat Capacity and Entropy

Low temperature data estimated. High temperature data from Gel'd and Kusenko⁵ up to 1800°K. Data at higher temperatures are estimated.

Melting and Vaporization

Melting temperature is from Elliott.⁶ Heat of fusion is estimated.

References

1. Kusenko, F. G. and P. V. Gel'd, Izv. Sibirsk. Otd. A. N. SSSR 1960, No. 2, 46-52 (1960).
2. Morozova, M. P. and T. A. Stolyarova, Zhur Ob Khim. 30, 3848 (1960).
3. Lavrent'ev, V. I., Y. I. Gerasimov and T. N. Rezukhina, Dokl. Akad. Nauk SSSR 136, 1372 (1961).
4. Brewer, L., Chem. Revs. 52, 1-75 (1953).
5. Gel'd, P. V. and F. G. Kusenko, Izv. Akad. Nauk SSSR O T. N. Met., Top 1960, No. 2, 79-86 (1960).
6. Elliott, R., Trans. Am. Soc. Metals 52, 990 (1960).

NIObIUM MONOXIDE (NbO) (CONDENSED PHASE) gfw = 108.91

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	C _T ^o	(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±0.500	±1.500	±1.500	±0.000	±2.000		
1000	±0.500	±2.105	±1.754	±0.351			
1500	±0.500	±2.308	±1.907	±0.601			
1800	±1.000	±2.308	±1.907	±0.601			
2000	±1.000	±2.595	±2.045	±1.101			
2218	±1.000	±2.699	±2.104	±1.319			
2218	±2.000	±4.502	±2.104	±5.319			
3000	±2.000	±5.106	±2.812	±6.883			
4000	±2.000	±5.682	±3.461	±8.883			
5000	±2.000	±6.128	±3.951	±10.883			
6000	±2.000	±6.493	±4.346	±12.883			

TABLE 176

NIOBIUM MONOXIDE

IDEAL MOLECULAR GAS

NbO

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Nb from 0° to 2741°K, Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K; Gaseous O₂; Gaseous NbO.

T, °K	C_p	$\frac{\text{cal}}{^\circ\text{K gfw}}$ S_T°	$\frac{\text{cal}}{^\circ\text{K gfw}}$ $-(F_T - H_{298}^\circ)/T$	$\frac{\text{Kcal}}{\text{gfw}}$ $H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.099	46.219	46.219	INFINITE
298.15	7.358	57.091	57.091	0.000	46.017	38.984	-28.575
300	7.366	57.136	57.091	0.014	46.013	38.941	-28.567
400	7.735	59.307	57.384	0.769	45.813	36.614	-20.004
500	8.034	61.067	57.950	1.558	45.628	34.335	-15.007
600	8.254	62.552	58.597	2.373	45.446	32.094	-11.690
700	8.413	63.837	59.255	3.207	45.263	29.883	-8.330
800	8.530	64.968	59.900	4.054	45.073	27.699	-7.567
900	8.618	65.978	60.520	4.912	44.876	25.539	-6.201
1000	8.686	66.890	61.113	5.777	44.670	23.400	-5.114
1100	8.739	67.720	61.676	6.649	44.456	21.285	-4.229
1200	8.782	68.483	62.212	7.525	44.232	19.188	-3.494
1300	8.817	69.187	62.722	8.405	43.997	17.110	-2.876
1400	8.847	69.842	63.207	9.288	43.752	15.052	-2.350
1500	8.872	70.453	63.670	10.174	43.498	13.010	-1.896
1600	8.893	71.026	64.112	11.062	43.233	10.986	-1.501
1700	8.913	71.566	64.535	11.953	42.958	8.977	-1.154
1800	8.931	72.076	64.940	12.845	42.677	6.987	-0.848
1900	8.947	72.559	65.328	13.739	42.375	5.014	-0.577
2000	8.963	73.018	65.701	14.634	42.067	3.057	-0.334
2100	8.979	73.456	66.060	15.531	41.748	1.114	-0.116
2200	8.994	73.874	66.406	16.430	41.419	-0.815	0.081
2300	9.011	74.275	66.740	17.330	41.079	-2.728	0.259
2400	9.029	74.658	67.062	18.232	40.728	-4.627	0.421
2500	9.048	75.027	67.373	19.136	40.367	-6.507	0.569
2600	9.069	75.383	67.674	20.042	39.996	-8.374	0.704
2700	9.092	75.726	67.966	20.950	39.615	-10.228	0.828
2741	9.102	75.863	68.083	21.323	39.456	-10.985	0.876
2741	9.102	75.863	68.083	21.323	39.456	-10.985	0.876
2800	9.118	76.057	68.249	21.860	32.843	-11.929	0.931
2900	9.146	76.377	68.524	22.773	32.482	-13.521	1.019
3000	9.177	76.688	68.791	23.690	32.123	-15.103	1.100
3100	9.211	76.989	69.051	24.609	31.764	-16.670	1.175
3200	9.248	77.283	69.304	25.532	31.406	-18.231	1.245
3300	9.288	77.568	69.550	26.459	31.051	-19.775	1.310
3400	9.332	77.846	69.790	27.390	30.696	-21.308	1.370
3500	9.379	78.117	70.024	28.325	30.341	-22.833	1.426
3600	9.429	78.382	70.253	29.265	29.995	-24.350	1.478
3700	9.482	78.642	70.476	30.211	29.651	-25.855	1.527
3800	9.539	78.895	70.695	31.162	29.309	-27.351	1.573
3900	9.598	79.144	70.908	32.119	28.972	-28.838	1.616
4000	9.661	79.388	71.118	33.082	28.639	-30.317	1.656
4100	9.726	79.628	71.322	34.051	28.310	-31.785	1.694
4200	9.794	79.863	71.523	35.027	27.986	-33.250	1.730
4300	9.865	80.094	71.720	36.010	27.668	-34.703	1.764
4400	9.938	80.322	71.913	37.000	27.357	-36.149	1.795
4500	10.013	80.547	72.103	37.997	27.045	-37.593	1.826
4600	10.090	80.768	72.289	39.003	26.743	-39.023	1.854
4700	10.168	80.986	72.472	40.015	26.444	-40.454	1.881
4800	10.249	81.201	72.652	41.036	26.152	-41.873	1.906
4900	10.330	81.414	72.829	42.065	25.864	-43.288	1.931
5000	10.413	81.623	73.003	43.102	25.581	-44.698	1.954
5031.58	10.440	81.689	73.057	43.431	25.491	-45.203	1.963
5031.58	10.440	81.689	73.057	43.431	-137.081	-45.203	1.963
5100	10.497	81.831	73.174	44.147	-137.314	-43.952	1.883
5200	10.582	82.036	73.343	45.201	-137.657	-42.118	1.770
5300	10.667	82.238	73.510	46.263	-138.003	-40.286	1.661
5400	10.753	82.439	73.673	47.334	-138.354	-38.434	1.555
5500	10.839	82.637	73.835	48.413	-138.710	-36.585	1.454
5600	10.925	82.834	73.994	49.501	-139.072	-34.727	1.355
5700	11.012	83.028	74.152	50.598	-139.443	-32.865	1.260
5800	11.098	83.221	74.307	51.703	-139.826	-30.987	1.168
5900	11.184	83.412	74.460	52.816	-140.224	-29.108	1.078
6000	11.269	83.601	74.611	53.939	-140.637	-27.219	0.991

15 September 1963

HLS

NIOBIUM MONOXIDE (NbO)

(IDEAL MOLECULAR GAS)

gfw = 108.91

$$\Delta H_{f0}^{\circ} = + 46.219 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = + 46.017 \text{ kcal gfw}^{-1}$$

Ground State Configuration $^2\Lambda$

$$S_{298.15}^{\circ} = 57.091 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.099 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	a_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$X^2\Lambda$	4	0.0	989.03	3.83		0.4323	0.0024	-	0.26
C	4	15,400	919.5	20.3	-	0.41	-	-	-
B	4	18,280	998.	16.0	-	0.41	-	-	-
$A^2\Lambda$	4	21,385.3	850.48	3.37	-	0.4003	0.0020	-	0.30

Heat of Formation

Based on work of Shchukarev et al.¹

Heat Capacity and Entropy

Calculated using constants shown above.²⁻⁵

References

1. Shchukarev, S. A., et al., Izv. V. U. Z. Khim. i Khim. Tekh. 5, 691 (1962).
2. Uhler, U., Naturwissenschaften 41, 137-8 (1954).
3. Uhler, U. Arkiv Fysik 8, 265 (1954).
4. Rao, V. R., Ind. J. Physics 24, 35 (1950).
5. Rao, V. R. and D. Premaswarup, Ind. J. Physics 27, 399 (1953).

NIOBIUM MONOXIDE (NbO)

(IDEAL MOLECULAR GAS)

GFW = 108.91

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔI_f°	log K _p
298.15	±1.000	±1.000	±1.000	±0.000	±5.000		
1000	±1.000	±2.210	±1.508	±0.702			
2000	±1.000	±2.903	±2.052	±1.702			
3000	±1.000	±3.309	±2.408	±2.702			
4000	±1.000	±3.596	±2.671	±3.702			
5000	±1.000	±3.820	±2.879	±4.702			
6000	±1.000	±4.002	±3.052	±5.702			

TABLE 177

NIOBIUM DIOXIDE

CONDENSED PHASE



Reference State for Calculating ΔH_f° , ΔK_f° , and Log Kp: Solid Nb from 0° to 2741°K,
 α -NbO₂ from 0° to 1090°K, β -NbO₂ from 1090° to 1200°K, γ -NbO₂ from 1200° to 2270°K,
 Liquid NbO₂ from 2270° to 6000°K.

T, °K	C_p	S_T	$-(F_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-2.222	-189.083	-189.083	INFINITE
298.15	13.740	13.030	13.030	0.000	-190.200	-176.790	129.584
300	13.768	13.115	13.030	0.025	-190.199	-176.707	128.725
400	15.074	17.262	13.587	1.470	-190.064	-172.227	94.096
500	16.192	20.748	14.679	3.034	-189.840	-167.792	73.339
600	17.236	23.793	15.949	4.706	-189.543	-163.409	59.519
700	18.245	26.526	17.268	6.480	-189.174	-159.082	49.665
800	19.235	29.027	18.584	8.354	-188.736	-154.813	42.291
900	20.215	31.349	19.875	10.327	-188.225	-150.603	36.570
1000	21.188	33.530	21.132	12.397	-187.640	-146.452	32.006
1090	22.060	35.393	22.233	14.343	-187.049	-142.770	28.625
1090	22.200	36.053	22.233	15.063	-186.329	-142.770	28.625
1100	22.200	36.256	22.360	15.285	-186.258	-142.371	28.285
1200	22.200	38.187	23.600	17.505	-185.562	-138.413	25.207
1200	19.850	38.187	23.600	17.505	-185.562	-138.413	25.207
1300	19.850	39.776	24.784	19.490	-185.120	-134.503	22.611
1400	19.850	41.247	25.908	21.475	-184.695	-130.624	20.390
1500	19.850	42.617	26.977	23.460	-184.285	-126.777	18.471
1600	19.850	43.898	27.995	25.445	-183.892	-122.957	16.794
1700	19.850	45.101	28.966	27.430	-183.514	-119.160	15.318
1800	19.850	46.236	29.894	29.415	-183.152	-115.385	14.009
1900	19.850	47.309	30.783	31.400	-182.805	-111.629	12.840
2000	19.850	48.327	31.635	33.385	-182.473	-107.890	11.789
2100	19.850	49.296	32.453	35.370	-182.157	-104.169	10.841
2200	19.850	50.219	33.240	37.355	-181.855	-100.464	9.980
2270	19.850	50.841	33.773	38.745	-181.652	-97.877	9.423
2270	20.000	57.449	33.773	53.745	-166.652	-97.877	9.423
2300	20.000	57.712	34.083	54.345	-166.563	-96.967	9.214
2400	20.000	58.563	35.086	56.345	-166.277	-93.950	8.555
2500	20.000	59.379	36.041	58.345	-166.006	-90.940	7.950
2600	20.000	60.164	36.954	60.345	-165.749	-87.942	7.392
2700	20.000	60.918	37.828	62.345	-165.507	-84.957	6.876
2741	20.000	61.220	38.175	63.165	-165.412	-83.734	6.676
2741	20.000	61.220	38.175	63.165	-171.812	-83.734	6.676
2800	20.000	61.646	38.665	64.345	-171.660	-81.837	6.387
2900	20.000	62.348	39.470	66.345	-171.438	-78.634	5.926
3000	20.000	63.026	40.244	68.345	-171.187	-75.441	5.496
3100	20.000	63.681	40.989	70.345	-170.917	-72.248	5.093
3200	20.000	64.316	41.709	72.345	-170.679	-69.077	4.717
3300	20.000	64.932	42.403	74.345	-170.444	-65.902	4.364
3400	20.000	65.529	43.074	76.345	-170.214	-62.734	4.032
3500	20.000	66.109	43.724	78.345	-169.988	-59.577	3.720
3600	20.000	66.672	44.354	80.345	-169.766	-56.428	3.425
3700	20.000	67.220	44.965	82.345	-169.547	-53.285	3.147
3800	20.000	67.753	45.557	84.345	-169.332	-50.140	2.884
3900	20.000	68.273	46.133	86.345	-169.121	-47.008	2.634
4000	20.000	68.779	46.693	88.345	-168.917	-43.876	2.397
4100	20.000	69.273	47.238	90.345	-168.709	-40.755	2.172
4200	20.000	69.755	47.768	92.345	-168.509	-37.633	1.958
4300	20.000	70.226	48.285	94.345	-168.312	-34.519	1.754
4400	20.000	70.685	48.789	96.345	-168.120	-31.408	1.560
4500	20.000	71.135	49.280	98.345	-167.931	-28.304	1.375
4600	20.000	71.574	49.760	0.345	-167.747	-25.198	1.197
4700	20.000	72.005	50.229	102.345	-167.568	-22.105	1.028
4800	20.000	72.426	50.687	104.345	-167.395	-19.008	0.865
4900	20.000	72.838	51.135	106.345	-167.228	-15.917	0.710
5000	20.000	73.242	51.573	108.345	-167.069	-12.830	0.561
5031.58	20.000	73.368	51.710	108.977	-167.021	-11.921	0.518
5031.58	20.000	73.368	51.710	108.977	-329.594	-11.921	0.518
5100	20.000	73.638	52.002	110.345	-329.534	-7.600	0.326
5200	20.000	74.027	52.422	112.345	-329.461	-1.284	0.054
5300	20.000	74.407	52.833	114.345	-329.406	5.025	-0.207
5400	20.000	74.781	53.236	116.345	-329.371	11.339	-0.459
5500	20.000	75.148	53.631	118.345	-329.359	17.650	-0.701
5600	20.000	75.509	54.019	120.345	-329.373	23.955	-0.935
5700	20.000	75.863	54.399	122.345	-329.417	30.270	-1.161
5800	20.000	76.211	54.772	124.345	-329.497	36.592	-1.379
5900	20.000	76.552	55.138	126.345	-329.618	42.909	-1.589
6000	20.000	76.889	55.498	128.345	-329.787	49.230	-1.793

15 September 1963

HLS

NIOBIUM DIOXIDE (NbO₂)

(CONDENSED PHASE)

gfw = 124.91

$$\Delta H_{f,298.15}^{\circ} = -190.2 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 13.03 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_t = 1090^{\circ}\text{K}$$

$$\Delta H_t = 0.720 \text{ kcal gfw}^{-1}$$

$$T_t = 1200^{\circ}\text{K}$$

$$\Delta H_t = 0$$

$$T_m = 2270^{\circ}\text{K}$$

$$\Delta H_m = 15.0 \text{ cal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.222 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 11.70 + 9.56 \times 10^{-3}T - 0.72 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 1090^{\circ}\text{K}$$

$$C_p^{\circ} = 22.20 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1090^{\circ}\text{K} \leq T \leq 1200^{\circ}\text{K}$$

$$C_p^{\circ} = 19.85 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1200^{\circ}\text{K} \leq T \leq 2270^{\circ}\text{K}$$

$$C_p^{\circ} = 20.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2270^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

Brauer¹ reported that NbO₂ has a narrow range of homogeneity with a structure related to that of rutile. Other forms appear possible.

Heat of Formation

Three calorimetric determinations were recomputed.²⁻⁴ See volume 1, this study (section IVB15.4.2) for details.

Heat Capacity and Entropy

Low temperature data from King.⁵ Data from 298.15 to 1800°K from King and Christensen.⁶ Data above 1800°K are estimated.

Melting and Vaporization

Melting temperature is average of two determinations.

References

1. Brauer, G., Z. Anorg. Chem. **248**, 1-31 (1941).
2. Morozova M. P. and T. A. Stolyarova, Zhur. Ob. Khim. **30**, 3848 (1960).
3. Kusenko, F. G. and P. V. Gel'd, Izv. Sibir Otd A. N. S. S. S. R. **1960**, No. 2, 46-52 (1960).
4. Mah, A. D., J. Am. Chem. Soc. **80**, 3872 (1958).
5. King, E. G., J., Am. Chem. Soc. **80**, 1799 (1958).
6. King, E. G. and A. U. Christensen, Bur Mines Rept **5789** (1961).

NIOBIUM DIOXIDE (NbO₂)

(CONDENSED PHASE)

GFW = 124.91

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p	S _T	(H _T - H ₂₉₈)/T	H _T - H ₂₉₈	ΔH _f	ΔF ₁	
298.15	±0.200	±0.070	±0.070	±0.000	±1.000		
1000	±0.200	±0.312	±0.172	±0.140			
1090	±0.200	±0.329	±0.184	±0.158			
1090	±0.500	±0.421	±0.184	±0.258			
1200	±0.500	±0.469	±0.208	±0.313			
1200	±1.000	±0.552	±0.208	±0.413			
1500	±1.000	±0.776	±0.300	±0.713			
2000	±1.000	±1.063	±0.457	±1.213			
2270	±1.000	±1.190	±0.536	±1.483			
2270	±2.000	±3.393	±0.536	±6.483			
3000	±2.000	±3.950	±1.302	±7.943			
4000	±2.000	±4.526	±2.040	±9.943			
5000	±2.000	±4.977	±2.583	±11.943			
6000	±2.000	±5.336	±3.013	±13.943			

TABLE 178

NIOBIUM DIOXIDE

IDEAL MOLECULAR GAS

NbO₂

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Nb from 0° to 2741°K,
Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K; Gaseous O₂; Gaseous NbO₂.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-2.691	-50.403	-50.403	INFINITE
298.15	11.218	61.031	61.031	0.000	-51.051	-51.953	38.080
300	11.239	61.101	61.031	0.021	-51.054	-51.958	37.850
400	12.314	64.484	61.485	1.200	-51.185	-52.237	28.540
500	13.236	67.334	62.377	2.478	-51.247	-52.492	22.943
600	13.986	69.816	63.415	3.841	-51.259	-52.739	19.209
700	14.562	72.018	64.490	5.270	-51.235	-52.989	16.543
800	14.980	73.991	65.556	6.748	-51.193	-53.241	14.544
900	15.267	75.773	66.594	8.261	-51.142	-53.501	12.991
1000	15.452	77.392	67.594	9.798	-51.090	-53.765	11.750
1100	15.562	78.871	68.553	11.349	-51.045	-54.034	10.735
1200	15.619	80.227	69.470	12.909	-51.009	-54.308	9.890
1300	15.639	81.479	70.346	14.472	-50.989	-54.584	9.176
1400	15.636	82.638	71.183	16.036	-50.985	-54.860	8.564
1500	15.618	83.716	71.983	17.599	-50.997	-55.137	8.033
1600	15.591	84.723	72.748	19.159	-51.029	-55.413	7.569
1700	15.559	85.667	73.481	20.717	-51.078	-55.687	7.159
1800	15.524	86.556	74.183	22.271	-51.147	-55.956	6.794
1900	15.489	87.394	74.856	23.821	-51.235	-56.219	6.466
2000	15.454	88.188	75.503	25.369	-51.340	-56.477	6.171
2100	15.421	88.941	76.125	26.912	-51.466	-56.732	5.904
2200	15.390	89.657	76.724	28.453	-51.608	-56.980	5.660
2300	15.360	90.341	77.302	29.990	-51.769	-57.222	5.437
2400	15.332	90.994	77.859	31.525	-51.948	-57.457	5.232
2500	15.306	91.619	78.397	33.057	-52.145	-57.681	5.042
2600	15.282	92.219	78.917	34.586	-52.359	-57.897	4.866
2700	15.259	92.795	79.420	36.113	-52.590	-58.106	4.703
2741	15.251	93.025	79.622	36.739	-52.689	-58.191	4.640
2741	15.251	93.025	79.622	36.739	-59.089	-58.191	4.640
2800	15.238	93.350	79.908	37.638	-59.218	-58.169	4.540
2900	15.219	93.884	80.381	39.161	-59.443	-58.127	4.380
3000	15.201	94.400	80.839	40.682	-59.674	-58.077	4.231
3100	15.185	94.898	81.285	42.201	-59.912	-58.017	4.090
3200	15.170	95.380	81.718	43.719	-60.156	-57.957	3.958
3300	15.155	95.847	82.139	45.235	-60.405	-57.882	3.833
3400	15.142	96.299	82.549	46.750	-60.660	-57.800	3.715
3500	15.130	96.738	82.948	48.264	-60.920	-57.712	3.603
3600	15.119	97.164	83.337	49.776	-61.186	-57.617	3.498
3700	15.108	97.578	83.716	51.287	-61.456	-57.515	3.397
3800	15.098	97.981	84.086	52.798	-61.730	-57.401	3.301
3900	15.089	98.373	84.448	54.307	-62.010	-57.287	3.210
4000	15.080	98.755	84.801	55.815	-62.294	-57.159	3.123
4100	15.072	99.127	85.146	57.323	-62.582	-57.029	3.040
4200	15.065	99.490	85.483	58.830	-62.875	-56.889	2.960
4300	15.058	99.844	85.813	60.336	-63.172	-56.740	2.884
4400	15.051	100.190	86.135	61.842	-63.474	-56.582	2.810
4500	15.045	100.529	86.452	63.346	-63.781	-56.428	2.740
4600	15.039	100.859	86.761	64.851	-64.092	-56.254	2.673
4700	15.034	101.183	87.065	66.354	-64.410	-56.085	2.608
4800	15.028	101.499	87.362	67.857	-64.734	-55.899	2.545
4900	15.023	101.809	87.654	69.360	-65.064	-55.711	2.485
5000	15.019	102.112	87.940	70.862	-65.403	-55.516	2.426
5031.58	15.017	102.207	88.029	71.336	-65.513	-55.514	2.411
5031.58	15.017	102.207	88.029	71.336	-228.086	-55.514	2.411
5100	15.015	102.410	88.221	72.364	-228.366	-53.167	2.278
5200	15.010	102.701	88.496	73.865	-228.792	-49.720	2.090
5300	15.006	102.987	88.767	75.366	-229.236	-46.276	1.908
5400	15.003	103.268	89.033	76.866	-229.701	-42.816	1.733
5500	14.999	103.543	89.294	78.366	-230.189	-39.347	1.563
5600	14.996	103.813	89.551	79.866	-230.703	-35.875	1.400
5700	14.993	104.078	89.804	81.365	-231.248	-32.389	1.242
5800	14.990	104.339	90.052	82.865	-231.828	-28.883	1.088
5900	14.987	104.595	90.296	84.363	-232.451	-25.374	0.940
6000	14.984	104.847	90.537	85.862	-233.121	-21.855	0.796

15 September 1963

HLS

NIOBIUM DIOXIDE (NbO₂)

(IDEAL MOLECULAR GAS)

gfw = 124.91

$$\Delta H_f^0 = -50.403 \text{ kcal gfw}^{-1}$$

$$\Delta H_f^{298.15} = -51.051 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S_{298.15} = 61.031 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^0 - H_0^0 = 2.691 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
913.6 (1)	1059.2 (1)
276.2 (2)	

Bond lengths and angles:

Nb-O distance = 1.691 Å

O-Nb-O angle = 180°

Moment of inertia:

$$I = 15.1918 \times 10^{-39} \text{ gm cm}^2$$

$$\sigma = 2$$

$$B_e = 0.18424 \text{ cm}^{-1}$$

Heat of Formation

Data of Shchukarev *et al*¹ was recalculated.

Heat Capacity and Entropy

Estimated structural data was used. Electronic levels were approximated as equal to those of Nb⁺⁴.

Reference

1. Shchukarev, S. A., G. A. Semenov, and K. E. Frantseva, Doklady Akad. Nauk SSSR 145, 119 (1962).

NIOBIUM DIOXIDE (NbO₂)

(IDEAL MOLECULAR GAS)

GFW = 124.91

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p^0	S_T^0	$-(F_T^0 - H_{298}^0)/T$	$H_T^0 - H_{298}^0$	ΔH_f^0	ΔF_f^0	log K _p
298.15	±1.000	±3.000	±3.000	±0.000	±5.000		
1000	±1.000	±4.210	±3.508	±0.702			
2000	±1.000	±4.903	±4.052	±1.702			
3000	±1.000	±5.309	±4.408	±2.702			
4000	±1.000	±5.596	±4.671	±3.702			
5000	±1.000	±5.820	±4.879	±4.702			
6000	±1.000	±6.002	±5.052	±5.702			

TABLE 179

NIOBIUM PENTOXIDE

CONDENSED PHASE

Nb₂O₅

Reference State for Calculating ΔH_f° , ΔH_g° , and Log Kp: Solid Nb from 0° to 2741°K,
Liquid Nb from 2741° to 5032°K, Gaseous Nb from 5032° to 6000°K, Gaseous O₂,
Solid Nb₂O₅ from 0° to 1785°K, Liquid Nb₂O₅ from 1785° to 6000°K.

T, °K	C_p	C_T	$-(F_T - H_{298}^\circ)/T$	$H_T - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-5.325	-452.210	-452.210	INFINITE
298-15	31.564	32.800	32.800	0.000	-454.600	-422.484	309.674
300	31.658	32.996	32.801	0.058	-454.596	-422.285	307.620
400	35.135	42.640	34.092	3.419	-454.210	-411.565	224.858
500	37.020	50.700	36.631	7.035	-453.640	-400.968	175.255
600	38.278	57.567	39.562	10.803	-453.000	-390.491	142.229
700	39.239	63.542	42.570	14.681	-452.320	-380.128	118.676
800	40.043	68.836	45.529	18.646	-451.626	-369.862	101.037
900	40.755	73.594	48.387	22.686	-450.917	-359.684	87.339
1000	41.410	77.922	51.127	26.795	-450.192	-349.583	76.398
1100	42.028	81.898	53.747	30.967	-449.452	-339.558	67.461
1200	42.620	85.581	56.248	35.199	-448.692	-329.601	60.026
1300	43.195	89.015	58.638	39.490	-447.915	-319.711	53.746
1400	43.757	92.237	60.924	43.838	-447.119	-309.878	48.372
1500	44.309	95.274	63.114	48.241	-446.301	-300.104	43.723
1600	44.854	98.152	65.214	52.700	-445.455	-290.385	39.663
1700	45.393	100.887	67.233	57.212	-444.608	-280.721	36.087
1785	45.848	103.113	68.889	61.090	-443.864	-272.541	33.367
1785	57.900	116.889	68.889	85.680	-419.274	-272.541	33.367
1800	57.900	117.373	69.291	86.548	-418.963	-271.312	32.940
1900	57.900	120.504	71.905	92.338	-416.896	-263.165	30.269
2000	57.900	123.474	74.409	98.128	-414.862	-255.120	27.877
2100	57.900	126.298	76.814	103.918	-412.863	-247.186	25.724
2200	57.900	128.992	79.125	109.708	-410.894	-239.344	23.776
2300	57.900	131.566	81.349	115.498	-408.958	-231.589	22.005
2400	57.900	134.030	83.493	121.288	-407.057	-223.920	20.390
2500	57.900	136.394	85.562	127.078	-405.189	-216.326	18.910
2600	57.900	138.664	87.561	132.868	-403.351	-208.805	17.551
2700	57.900	140.850	89.495	138.658	-401.546	-201.363	16.298
2741	57.900	141.722	90.269	141.032	-400.815	-198.330	15.813
2741	57.900	141.722	90.269	141.032	-413.615	-198.330	15.813
2800	57.900	142.955	91.367	144.448	-412.533	-193.704	15.119
2900	57.900	144.987	93.181	150.238	-410.713	-185.919	14.011
3000	57.900	146.950	94.941	156.028	-408.903	-178.203	12.981
3100	57.900	148.848	96.649	161.818	-407.100	-170.530	12.022
3200	57.900	150.687	98.309	167.608	-405.321	-162.938	11.128
3300	57.900	152.468	99.923	173.398	-403.543	-155.386	10.290
3400	57.900	154.197	101.494	179.188	-401.778	-147.888	9.506
3500	57.900	155.875	103.024	184.978	-400.023	-140.445	8.769
3600	57.900	157.506	104.515	190.768	-398.278	-133.057	8.077
3700	57.900	159.093	105.969	196.558	-396.541	-125.718	7.426
3800	57.900	160.637	107.387	202.348	-394.813	-118.412	6.810
3900	57.900	162.141	108.772	208.138	-393.096	-111.164	6.229
4000	57.900	163.607	110.125	213.928	-391.386	-103.950	5.679
4100	57.900	165.036	111.447	219.718	-389.686	-96.789	5.159
4200	57.900	166.432	112.739	225.508	-387.996	-89.662	4.665
4300	57.900	167.794	114.004	231.298	-386.313	-82.573	4.197
4400	57.900	169.125	115.241	237.088	-384.643	-75.522	3.751
4500	57.900	170.426	116.453	242.878	-382.981	-68.523	3.328
4600	57.900	171.699	117.641	248.668	-381.331	-61.544	2.924
4700	57.900	172.944	118.804	254.458	-379.693	-54.511	2.539
4800	57.900	174.163	119.945	260.248	-378.071	-47.706	2.172
4900	57.900	175.357	121.063	266.038	-376.463	-40.832	1.821
5000	57.900	176.527	122.161	271.828	-374.876	-34.000	1.486
5031.58	57.900	176.891	122.503	273.657	-374.380	-31.970	1.389
5031.58	57.900	176.891	122.503	273.657	-699.526	-31.970	1.389
5100	57.900	177.673	123.238	277.618	-698.541	-22.900	0.981
5200	57.900	178.798	124.296	283.408	-697.135	-9.657	0.406
5300	57.900	179.900	125.335	289.198	-695.771	3.545	-0.146
5400	57.900	180.983	126.355	294.988	-694.455	16.739	-0.677
5500	57.900	182.045	127.358	300.778	-693.194	29.903	-1.188
5600	57.900	183.088	128.344	306.568	-691.995	43.036	-1.679
5700	57.900	184.113	129.314	312.358	-690.869	56.160	-2.153
5800	57.900	185.120	130.267	318.148	-689.831	69.282	-2.610
5900	57.900	186.110	131.205	323.938	-688.894	82.371	-3.051
6000	57.900	187.083	132.128	329.728	-688.074	95.456	-3.477

15 September 1963

HLS

NIOBIUM PENTOXIDE (Nb₂O₅)
(CONDENSED PHASE)
gfw = 265.82

$$\Delta H_{f298.15}^{\circ} = -454.6 \pm 1.0 \text{ kcal gfw}^{-1} \quad S_{298.15}^{\circ} = 32.8 \pm 0.2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 1785^{\circ}\text{K}$$

$$\Delta H_m = 24,590 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 5.325 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 36.90 + 5.12 \times 10^{-3}T - 6.10 \times 10^{-5}T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 1785^{\circ}\text{K}$$

$$C_p^{\circ} = 57.90 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1785^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

The α -Nb₂O₅ (high temperature form) reported by Holtzberg¹ was considered to have a monoclinic unit cell.

Heat of Formation

Average of five calorimetric measurements.²⁻⁶

Heat Capacity and Entropy

Low temperature data from King.⁷ High temperature data from Kelley.⁸ Data above 1809°K were extrapolated.

Melting and Vaporization

Heat of melting was from Kelley⁸ and Orr.⁹

References

1. Holtzberg, F. et al, J. Am. Chem. Soc. 79, 2039 (1957).
2. Humphrey, G. L., J. Am. Chem. Soc. 76, 978 (1954).
3. Morozova, M. P. and T. A. Stolyarova, Zhur Ob. Khim 30, 3848 (1960).
4. Kusenko, F. G. and P. V. Gel'd, Zhur Ob. Khim 30, 3847 (1960).
5. Huber, E. G. Jr., et al, J. Phys. Chem. 65, 1846 (1961).
6. Kornilov, A. N., et al, Dokl. Akad Nauk SSSR 144, 355 (1962).
7. King, E. G., J. Am. Chem. Soc 76, 3289 (1954).
8. Kelley, K. K., U.S. Bur. Mines Bull. 584 (1960).
9. Orr, R. L., J. Am. Chem. Soc. 75, 2808 (1953).

NIOBIUM PENTOXIDE (Nb₂O₅)
(CONDENSED PHASE)
GFW = 265.82
SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	$\frac{\text{cal/}^{\circ}\text{K gfw}}{T}$	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$\frac{\text{Kcal gfw}}{H_T^{\circ} - H_{298}^{\circ}}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.300	±0.200	±0.200	±0.000	±1.000		
500	±0.300	±0.355	±0.234	±0.061			
500	±1.000	±0.355	±0.234	±0.061			
1000	±1.000	±1.048	±0.488	±0.561			
1785	±1.000	±1.628	±0.874	±1.346			
1785	±1.000	±2.188	±0.874	±2.346			
2000	±1.000	±2.302	±1.021	±2.561			
2000	±2.000	±2.302	±1.021	±2.561			
3000	±2.000	±3.113	±1.592	±4.561			
3000	±3.000	±3.113	±1.592	±4.561			
4000	±3.000	±3.976	±2.085	±7.561			
5000	±3.000	±4.645	±2.533	±10.561			
6000	±3.000	±5.192	±2.932	±13.561			

TABLE 180

OXYGEN

IDEAL MONATOMIC GAS

0

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$
Gaseous O_2 from 0° to $6000^\circ K$.

T, °K	cal/°K gfw			Kcal/gfw			Log K_p
	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
0	0.000	0.000	INFINITE	-1.608	58.986	58.986	INFINITE
298.15	5.237	38.469	38.469	0.000	59.557	55.393	-40.602
300	5.235	38.501	38.469	0.010	59.561	55.367	-40.333
400	5.135	39.992	38.673	0.528	59.724	53.945	-29.473
500	5.081	41.131	39.055	1.038	59.868	52.483	-22.939
600	5.049	42.054	39.480	1.544	59.996	50.994	-18.547
700	5.029	42.831	39.905	2.048	60.111	49.484	-15.449
800	5.015	43.502	40.314	2.550	60.214	47.959	-13.101
900	5.006	44.092	40.701	3.052	60.309	46.421	-11.272
1000	4.999	44.619	41.067	3.552	60.395	44.873	-9.806
1100	4.994	45.095	41.412	4.051	60.475	43.317	-8.606
1200	4.990	45.529	41.737	4.551	60.550	41.754	-7.604
1300	4.987	45.929	42.045	5.049	60.621	40.184	-6.755
1400	4.984	46.298	42.335	5.548	60.688	38.610	-6.027
1500	4.982	46.642	42.611	6.046	60.750	37.031	-5.395
1600	4.981	46.963	42.873	6.544	60.810	35.448	-4.842
1700	4.979	47.265	43.123	7.042	60.866	33.860	-4.353
1800	4.979	47.550	43.361	7.540	60.920	32.271	-3.918
1900	4.978	47.819	43.588	8.038	60.971	30.679	-3.529
2000	4.978	47.074	43.806	8.536	61.019	29.083	-3.178
2100	4.978	48.317	44.016	9.034	61.064	27.484	-2.860
2200	4.979	48.549	44.216	9.532	61.107	25.884	-2.571
2300	4.980	48.770	44.410	10.029	61.145	24.282	-2.307
2400	4.981	48.982	44.596	10.527	61.182	22.679	-2.065
2500	4.984	49.186	44.775	11.026	61.218	21.075	-1.842
2600	4.986	49.381	44.949	11.524	61.249	19.468	-1.636
2700	4.990	49.569	45.116	12.023	61.280	17.861	-1.446
2800	4.994	49.751	45.279	12.522	61.307	16.249	-1.268
2900	4.999	49.926	45.436	13.022	61.334	14.642	-1.103
3000	5.004	50.096	45.588	13.522	61.357	13.033	-0.949
3100	5.010	50.260	45.736	14.023	61.380	11.420	-0.805
3200	5.017	50.419	45.880	14.524	61.400	9.810	-0.670
3300	5.025	50.574	46.020	15.026	61.419	8.196	-0.543
3400	5.033	50.724	46.156	15.529	61.438	6.585	-0.423
3500	5.041	50.870	46.289	16.033	61.455	4.967	-0.310
3600	5.050	51.012	46.418	16.537	61.470	3.354	-0.204
3700	5.060	51.150	46.544	17.043	61.485	1.741	-0.103
3800	5.070	51.285	46.667	17.549	61.498	0.125	-0.007
3900	5.081	51.417	46.787	18.057	61.512	-1.490	0.083
4000	5.091	51.548	46.905	18.565	61.524	-3.107	0.170
4100	5.103	51.672	47.019	19.075	61.536	-4.719	0.252
4200	5.114	51.795	47.132	19.586	61.547	-6.337	0.330
4300	5.126	51.916	47.242	20.098	61.557	-7.953	0.404
4400	5.138	52.033	47.349	20.611	61.567	-9.567	0.475
4500	5.150	52.149	47.455	21.126	61.576	-11.188	0.543
4600	5.162	52.262	47.558	21.641	61.583	-12.801	0.608
4700	5.174	52.374	47.659	22.158	61.589	-14.416	0.670
4800	5.186	52.483	47.758	22.676	61.594	-16.033	0.730
4900	5.198	52.590	47.856	23.195	61.596	-17.652	0.787
5000	5.210	52.695	47.952	23.715	61.596	-19.268	0.842
5100	5.222	52.798	48.046	24.237	61.593	-20.885	0.895
5200	5.234	52.900	48.138	24.760	61.586	-22.499	0.946
5300	5.246	52.999	48.229	25.284	61.574	-24.114	0.994
5400	5.258	53.098	48.318	25.809	61.555	-25.731	1.041
5500	5.269	53.194	48.406	26.335	61.528	-27.348	1.087
5600	5.280	53.289	48.492	26.863	61.493	-28.957	1.130
5700	5.292	53.383	48.577	27.392	61.445	-30.571	1.172
5800	5.302	53.475	48.661	27.921	61.383	-32.182	1.213
5900	5.313	53.566	48.743	28.452	61.303	-33.793	1.252
6000	5.323	53.655	48.824	28.984	61.202	-35.399	1.289

May 1962

RCF

OXYGEN, MONATOMIC (O)

(IDEAL GAS)

gfw = 16.000

$$\Delta H_{f0}^{\circ} = 58.986 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 59.557 \text{ kcal gfw}^{-1}$$

Ground State Configuration = 3P_2

$$S_{298.15}^{\circ} = 38.469 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.608 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Energy levels from Moore.¹

Heat of Formation

Dissociation energy from Brix and Herzberg.²

Heat Capacity and Entropy

Calculated on monatomic gas-computer program.

See Barriault et al³ for further details.

References

1. Moore, C. Atomic Energy Levels, Vol. 1, Nat. Bur. Stds. (1949).
2. Brix, P. and G. Herzberg, J. Chem. Phys. 21, 2240 (1953).
3. Barriault, R. J. et al, ASD TR 61-260 (May 1962), Pt. 1.

OXYGEN, MONATOMIC (O)

(IDEAL GAS)

GFW = 16.000

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	$\log K_p$
298.15	±0.000	±0.002	±0.002	±0.000	±0.020	±0.021	±0.015
1000	±0.000	±0.002	±0.002	±0.000	±0.021	±0.024	±0.005
2000	±0.000	±0.002	±0.002	±0.000	±0.022	±0.028	±0.003
3000	±0.000	±0.002	±0.002	±0.000	±0.025	±0.032	±0.002
4000	±0.000	±0.002	±0.003	±0.001	±0.035	±0.044	±0.002
5000	±0.000	±0.002	±0.003	±0.001	±0.078	±0.053	±0.002
6000	±0.000	±0.002	±0.003	±0.001	±0.428	±0.077	±0.003

TABLE 181

OSMIUM MONOXIDE

IDEAL MOLECULAR GAS

00s

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Os from 0° to 3290°K, Liquid Os from 3290° to 5270°K, Gaseous Os from 5270° to 6000°K; Gaseous O_2 ; Gaseous OsO_4 .

T, °K	C_p	S_T	$-(F_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.124	102.123	102.123	INFINITE
298.15	7.614	60.396	60.396	0.000	102.000	93.624	-68.625
300	7.623	60.433	60.396	0.014	101.997	93.572	-68.164
400	8.003	62.691	60.700	0.706	101.873	90.791	-49.603
500	8.263	64.507	61.786	1.611	101.665	88.051	-38.485
600	8.436	66.030	61.953	2.446	101.504	85.343	-31.085
700	8.554	67.340	62.631	3.296	101.339	82.663	-25.807
800	8.636	68.488	63.293	4.156	101.166	80.006	-21.856
900	8.695	69.509	63.928	5.022	100.981	77.377	-18.788
1000	8.734	70.427	64.533	5.894	100.787	74.760	-16.338
1100	8.773	71.262	65.107	6.770	100.581	72.167	-14.338
1200	8.799	72.026	65.652	7.649	100.366	69.593	-12.674
1300	8.814	72.711	66.170	8.530	100.139	67.037	-11.269
1400	8.836	73.386	66.662	9.412	99.901	64.501	-10.069
1500	8.849	73.996	67.131	10.297	99.656	61.981	-9.030
1600	8.860	74.567	67.578	11.182	99.396	59.476	-8.124
1700	8.869	75.105	68.005	12.069	99.127	56.991	-7.326
1800	8.877	75.612	68.414	12.956	98.854	54.519	-6.619
1900	8.884	76.092	68.806	13.844	98.560	52.053	-5.988
2000	8.889	76.548	69.181	14.733	98.255	49.626	-5.423
2100	8.894	76.982	69.543	15.622	97.941	47.202	-4.912
2200	8.899	77.395	69.890	16.511	97.616	44.794	-4.450
2300	8.902	77.791	70.225	17.402	97.283	42.399	-4.029
2400	8.905	78.170	70.548	18.292	96.936	40.021	-3.644
2500	8.908	78.534	70.861	19.183	96.579	37.654	-3.292
2600	8.911	78.883	71.162	20.074	96.210	35.309	-2.968
2700	8.913	79.219	71.445	20.965	95.830	32.970	-2.669
2800	8.915	79.544	71.718	21.856	95.439	30.650	-2.392
2900	8.917	79.856	72.012	22.748	95.037	28.344	-2.136
3000	8.919	80.159	72.279	23.640	94.625	26.051	-1.898
3100	8.920	80.451	72.538	24.532	94.200	23.773	-1.676
3200	8.922	80.734	72.790	25.424	93.765	21.506	-1.469
3300	8.923	81.008	73.034	26.316	93.319	19.252	-1.277
3400	8.924	81.274	73.273	27.208	92.862	17.012	-1.100
3500	8.925	81.534	73.505	28.101	92.404	14.782	-0.954
3600	8.926	81.786	73.732	28.993	91.945	12.565	-0.807
3700	8.927	82.030	73.953	29.886	91.486	10.360	-0.670
3800	8.928	82.268	74.169	30.779	91.027	8.166	-0.540
3900	8.929	82.500	74.379	31.671	90.568	5.982	-0.417
4000	8.929	82.726	74.585	32.564	90.109	3.808	-0.302
4100	8.930	82.947	74.786	33.457	89.650	1.644	-0.193
4200	8.930	83.162	74.983	34.350	89.191	-0.517	-0.089
4300	8.931	83.372	75.176	35.243	88.732	-2.692	0.009
4400	8.932	83.577	75.364	36.137	88.273	-4.867	0.102
4500	8.932	83.778	75.549	37.030	87.814	-7.042	0.190
4600	8.933	83.974	75.730	37.923	87.355	-9.217	0.274
4700	8.933	84.166	75.908	38.816	86.896	-11.392	0.354
4800	8.933	84.355	76.082	39.709	86.437	-13.567	0.430
4900	8.934	84.539	76.252	40.603	85.978	-15.742	0.502
5000	8.934	84.719	76.420	41.496	85.519	-17.917	0.571
5100	8.934	84.896	76.584	42.390	85.060	-20.092	0.637
5200	8.935	85.070	76.746	43.283	84.601	-22.267	0.699
5269.57	8.935	85.189	76.857	43.909	84.142	-24.442	0.742
5269.57	8.935	85.189	76.857	43.909	84.142	-24.442	0.742
5300	8.935	85.240	76.905	44.177	83.683	-26.617	0.718
5400	8.935	85.407	77.061	45.070	83.224	-28.792	0.640
5500	8.936	85.571	77.214	45.964	82.765	-30.967	0.572
5600	8.936	85.732	77.364	46.857	82.306	-33.142	0.493
5700	8.936	85.890	77.513	47.751	81.847	-35.317	0.422
5800	8.936	86.045	77.658	48.644	81.388	-37.492	0.354
5900	8.936	86.198	77.802	49.538	80.929	-39.667	0.287
6000	8.937	86.348	77.943	50.431	80.470	-41.842	0.222

15 September 1962

RCF

OSMIUM MONOXIDE (OsO)

(IDEAL MOLECULAR GAS)

gfw = 206.2

$$\Delta H_{f0}^{\circ} = 102.123 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 102.000 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 6

$$S_{298.15}^{\circ} = 60.396 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.124 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	6	0.0	795	3.6	---	0.34	0.0019	---	0.24

Heat of Formation

Value estimated. See volume 1, this study (section IVB18.4.1) for details.

Heat Capacity and Entropy

Spectroscopic constants from Brewer et al¹ used.

Reference

1. Brewer, L. and M. S. Chandrasekharaiah, U. S. At. Energy Comm. Rept. UCRL-8713 Rev. (June 1960).

TABLE 182

PLATINUM MONOXIDE

IDEAL MOLECULAR GAS

Opt

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$ Solid Pt from 0° to 2043°K,
Liquid Pt from 2043° to 4108°K, Gaseous Pt from 4108° to 6000°K; Gaseous O_2 ; Gaseous PtO .

T, °K	C_p°	$\frac{cal}{^\circ K \text{ gfw}}$ C_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$\frac{Kcal}{gfw}$ $H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.125	88.797	88.797	INFINITE
298.15	7.631	60.495	60.495	0.000	88.600	80.836	-59.251
300	7.639	60.543	60.496	0.014	88.597	80.787	-58.851
400	8.019	62.795	60.800	0.798	88.399	78.215	-42.733
500	8.276	64.614	61.387	1.614	88.209	75.691	-33.083
600	8.447	66.140	62.055	2.451	88.015	73.206	-26.664
700	8.562	67.451	62.735	3.301	87.813	70.753	-22.089
800	8.643	68.600	63.397	4.162	87.599	68.331	-18.666
900	8.701	69.621	64.033	5.029	87.370	65.936	-16.011
1000	8.744	70.540	64.639	5.902	87.127	63.567	-13.892
1100	8.777	71.375	65.214	6.778	86.869	61.223	-12.163
1200	8.802	72.140	65.760	7.657	86.598	58.903	-10.727
1300	8.822	72.846	66.278	8.538	86.312	56.606	-9.516
1400	8.838	73.500	66.771	9.421	86.012	54.332	-8.481
1500	8.851	74.110	67.240	10.306	85.697	52.082	-7.588
1600	8.862	74.682	67.687	11.191	85.367	49.852	-6.809
1700	8.871	75.219	68.115	12.078	85.024	47.640	-6.124
1800	8.879	75.727	68.524	12.965	84.664	45.453	-5.518
1900	8.885	76.207	68.916	13.854	84.292	43.284	-4.979
2000	8.891	76.663	69.292	14.742	83.903	41.136	-4.495
2043	8.893	76.852	69.447	15.125	83.732	40.276	-4.308
2043	8.893	76.852	69.447	15.125	79.034	40.276	-4.308
2100	8.895	77.097	69.653	15.632	78.797	39.140	-4.073
2200	8.900	77.511	70.001	16.521	78.381	37.260	-3.701
2300	8.903	77.906	70.336	17.412	77.964	35.400	-3.364
2400	8.906	78.285	70.659	18.302	77.543	33.560	-3.056
2500	8.909	78.644	70.972	19.193	77.120	31.734	-2.774
2600	8.912	78.998	71.274	20.084	76.695	29.927	-2.515
2700	8.914	79.335	71.566	20.975	76.267	28.138	-2.277
2800	8.916	79.654	71.849	21.867	75.838	26.364	-2.058
2900	8.918	79.972	72.124	22.758	75.405	24.604	-1.854
3000	8.919	80.274	72.391	23.650	74.971	22.859	-1.665
3100	8.921	80.567	72.650	24.542	74.534	21.130	-1.490
3200	8.922	80.850	72.902	25.434	74.095	19.414	-1.326
3300	8.923	81.125	73.147	26.327	73.655	17.713	-1.173
3400	8.924	81.391	73.385	27.219	73.213	16.025	-1.030
3500	8.926	81.650	73.618	28.112	72.769	14.349	-0.896
3600	8.926	81.901	73.844	29.004	72.321	12.689	-0.770
3700	8.927	82.146	74.065	29.897	71.874	11.037	-0.652
3800	8.928	82.384	74.281	30.790	71.425	9.398	-0.541
3900	8.929	82.616	74.492	31.683	70.973	7.771	-0.435
4000	8.930	82.842	74.698	32.575	70.519	6.158	-0.336
4100	8.930	83.062	74.899	33.468	70.064	4.554	-0.243
4108.34	8.930	83.079	74.915	33.539	70.024	4.639	-0.247
4108.34	8.930	83.074	74.915	33.539	-51.495	4.639	-0.247
4200	8.931	83.277	75.096	34.461	-51.667	5.671	-0.295
4300	8.931	83.488	75.289	35.355	-51.861	7.038	-0.358
4400	8.932	83.693	75.478	36.148	-52.060	8.410	-0.418
4500	8.932	83.894	75.662	37.041	-52.264	9.792	-0.476
4600	8.933	84.090	75.843	37.934	-52.471	11.173	-0.531
4700	8.933	84.282	76.021	38.927	-52.684	12.559	-0.584
4800	8.934	84.470	76.195	39.721	-52.901	13.948	-0.635
4900	8.934	84.654	76.366	40.614	-53.123	15.343	-0.684
5000	8.934	84.835	76.533	41.508	-53.351	16.745	-0.732
5100	8.935	85.012	76.698	42.401	-53.587	18.144	-0.777
5200	8.935	85.185	76.859	43.294	-53.829	19.560	-0.822
5300	8.935	85.356	77.018	44.188	-54.080	20.975	-0.865
5400	8.935	85.523	77.174	45.082	-54.340	22.396	-0.906
5500	8.936	85.686	77.327	45.975	-54.611	23.818	-0.946
5600	8.936	85.847	77.478	46.869	-54.895	25.250	-0.985
5700	8.936	86.006	77.626	47.762	-55.195	26.687	-1.023
5800	8.936	86.161	77.772	48.656	-55.512	28.126	-1.060
5900	8.937	86.314	77.916	49.550	-55.850	29.571	-1.095
6000	8.937	86.464	78.057	50.443	-56.213	31.030	-1.130

15 December 1962

RCF

PLATINUM MONOXIDE (PtO) (IDEAL MOLECULAR GAS) gfw = 211.09

$$\Delta H_{f0}^{\circ} = 88.797 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 88.600 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 6

$$S_{298.15}^{\circ} = 60.495 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.125 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	6	0	785	—	—	0.334	—	—	—

Heat of Formation

Estimated by analogy to data for PtO₂.

Heat Capacity and Entropy

Calculated using above estimated constants. See volume 1, this study (section IVB20.4.1) for details.

TABLE 183

RHENIUM MONOXIDE

IDEAL MOLECULAR GAS

ORe

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Re from 0° to 3453°K, Liquid Re from 1453° to 5960°K, Gaseous Re from 5960° to 6000°K; Gaseous O₂; Gaseous ReO.

T, °K	C_p	S_T°	$-(H_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.113	90.231	90.231	INFINITE
298.15	7.515	59.382	59.382	0.000	90.000	82.250	-60.288
300	7.523	59.429	59.382	0.014	89.996	82.202	-59.881
400	7.905	61.647	59.682	0.786	89.791	79.636	-43.509
500	8.180	63.443	60.260	1.591	89.600	77.119	-33.707
600	8.368	64.952	60.920	2.419	89.408	74.640	-27.186
700	8.499	66.252	61.591	3.263	89.212	72.195	-22.539
800	8.591	67.393	62.246	4.118	89.004	69.778	-19.062
900	8.658	68.409	62.876	4.980	88.782	67.387	-16.363
1000	8.708	69.324	63.476	5.849	88.550	65.023	-14.210
1100	8.747	70.156	64.046	6.722	88.304	62.682	-12.453
1200	8.776	70.919	64.587	7.598	88.043	60.364	-10.993
1300	8.800	71.622	65.102	8.477	87.768	58.067	-9.762
1400	8.819	72.275	65.591	9.358	87.479	55.795	-8.710
1500	8.834	72.884	66.057	10.240	87.173	53.542	-7.801
1600	8.847	73.455	66.502	11.124	86.852	51.310	-7.008
1700	8.858	73.991	66.927	12.010	86.515	49.098	-6.312
1800	8.867	74.498	67.333	12.896	86.161	46.909	-5.695
1900	8.874	74.977	67.723	13.783	85.790	44.739	-5.146
2000	8.881	75.433	68.097	14.671	85.407	42.588	-4.654
2100	8.886	75.866	68.457	15.559	84.994	40.458	-4.210
2200	8.891	76.280	68.803	16.448	84.570	38.347	-3.809
2300	8.896	76.675	69.137	17.337	84.125	36.255	-3.445
2400	8.899	77.054	69.459	18.227	83.663	34.184	-3.113
2500	8.903	77.417	69.770	19.117	83.180	32.131	-2.809
2600	8.906	77.766	70.071	20.008	82.678	30.100	-2.530
2700	8.908	78.102	70.362	20.898	82.154	28.088	-2.273
2800	8.911	78.426	70.645	21.789	81.611	26.093	-2.037
2900	8.913	78.739	70.918	22.680	81.046	24.122	-1.818
3000	8.915	79.041	71.184	23.572	80.462	22.168	-1.615
3100	8.917	79.334	71.442	24.463	79.853	20.239	-1.427
3200	8.918	79.617	71.693	25.355	79.224	18.325	-1.251
3300	8.920	79.891	71.938	26.247	78.575	16.430	-1.088
3400	8.921	80.158	72.175	27.139	77.901	14.559	-0.936
3453	8.922	80.296	72.299	27.612	77.535	13.575	-0.859
3453	8.922	80.296	72.299	27.612	69.592	13.575	-0.859
3500	8.922	80.416	72.407	28.031	69.144	12.813	-0.800
3600	8.923	80.668	72.633	28.924	68.511	11.209	-0.680
3700	8.924	80.912	72.854	29.816	67.871	9.625	-0.568
3800	8.925	81.150	73.069	30.708	67.171	8.063	-0.464
3900	8.926	81.382	73.279	31.601	66.469	6.515	-0.365
4000	8.927	81.608	73.484	32.494	65.766	4.990	-0.273
4100	8.928	81.828	73.685	33.386	65.060	3.478	-0.185
4200	8.928	82.043	73.882	34.279	64.353	1.985	-0.103
4300	8.929	82.254	74.074	35.172	63.645	0.508	-0.026
4400	8.930	82.459	74.262	36.065	62.934	-0.952	0.047
4500	8.930	82.660	74.447	36.958	62.221	-2.399	0.116
4600	8.931	82.856	74.627	37.851	61.506	-3.822	0.182
4700	8.931	83.048	74.804	38.744	60.789	-5.231	0.243
4800	8.932	83.236	74.978	39.637	60.068	-6.631	0.302
4900	8.932	83.420	75.149	40.530	59.345	-8.012	0.357
5000	8.933	83.601	75.316	41.424	58.618	-9.380	0.410
5100	8.933	83.777	75.480	42.317	57.886	-10.730	0.460
5200	8.933	83.951	75.641	43.210	57.149	-12.066	0.507
5300	8.934	84.121	75.800	44.104	56.407	-13.395	0.552
5400	8.934	84.288	75.955	44.997	55.656	-14.701	0.595
5500	8.934	84.452	76.108	45.890	54.896	-15.993	0.635
5600	8.935	84.613	76.259	46.784	54.127	-17.276	0.674
5700	8.935	84.771	76.407	47.677	53.344	-18.545	0.711
5800	8.935	84.927	76.552	48.571	52.546	-19.791	0.746
5900	8.935	85.079	76.695	49.464	51.728	-21.026	0.779
5960.67	8.936	85.169	76.780	50.000	51.219	-21.762	0.798
5960.67	8.936	85.169	76.780	50.000	-117.096	-21.762	0.798
6000	8.936	85.229	76.836	50.358	-117.511	-21.132	0.770

15 December 1962

RCF

RHENIUM MONOXIDE (ReO) (IDEAL MOLECULAR GAS) gfw = 202.22

$$\Delta H_{f0}^{\circ} = 90.231 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 90.000 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 4

$$S_{298.15}^{\circ} = 59.382 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.113 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	4	0	858	—	—	0.355	—	—	—

Heat of Formation

Estimated by comparison with neighboring elements in periodic table.

Heat Capacity and Entropy

Calculated using above estimated spectroscopic constants. See volume 1, this study (section IVB21.4.1) for details.

TABLE 184

RHODIUM MONOXIDE

IDEAL MOLECULAR GAS

ORh

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Rh from 0° to 2239°K,
Liquid Rh from 2239° to 3996°K, Gaseous Rh from 3996° to 6000°K; Gaseous O₂; Gaseous RhO.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.119	88.691	88.691	INFINITE
298.15	7.575	57.727	57.727	0.000	88.400	80.739	-59.181
300	7.583	57.774	57.727	0.014	88.396	80.692	-58.781
400	7.965	60.011	58.030	0.792	88.209	78.152	-42.698
500	8.231	61.819	58.613	1.603	88.015	75.659	-33.069
600	8.411	63.336	59.277	2.436	87.806	73.208	-26.665
700	8.533	64.643	59.952	3.283	87.578	70.793	-22.101
800	8.619	65.788	60.612	4.141	87.330	68.412	-18.688
900	8.682	66.807	61.244	5.006	87.060	66.063	-16.042
1000	8.728	67.724	61.847	5.877	86.768	63.745	-13.931
1100	8.763	68.558	62.420	6.752	86.453	61.458	-12.210
1200	8.790	69.322	62.964	7.629	86.116	59.201	-10.781
1300	8.812	70.026	63.480	8.509	85.756	56.972	-9.577
1400	8.829	70.680	63.971	9.392	85.376	54.772	-8.550
1500	8.844	71.289	64.439	10.275	84.972	52.600	-7.663
1600	8.855	71.861	64.885	11.160	84.547	50.455	-6.892
1700	8.865	72.398	65.312	12.046	84.099	48.338	-6.214
1800	8.873	72.905	65.720	12.933	83.628	46.247	-5.615
1900	8.880	73.385	66.110	13.821	83.136	44.186	-5.082
2000	8.886	73.840	66.486	14.709	82.621	42.148	-4.605
2100	8.891	74.274	66.846	15.598	82.083	40.139	-4.177
2200	8.896	74.688	67.193	16.487	81.523	38.155	-3.790
2239	8.898	74.843	67.324	16.834	81.299	37.389	-3.649
2239	8.898	74.843	67.324	16.834	76.149	37.389	-3.649
2300	8.900	75.083	67.528	17.377	75.803	36.334	-3.452
2400	8.903	75.462	67.851	18.267	75.231	34.629	-3.153
2500	8.906	75.826	68.162	19.158	74.659	32.951	-2.880
2600	8.909	76.175	68.464	20.049	74.083	31.295	-2.630
2700	8.911	76.511	68.756	20.940	73.506	29.657	-2.400
2800	8.914	76.835	69.039	21.831	72.925	28.046	-2.189
2900	8.916	77.148	69.313	22.722	72.342	26.455	-1.994
3000	8.917	77.450	69.579	23.614	71.758	24.882	-1.813
3100	8.919	77.743	69.838	24.506	71.172	23.329	-1.645
3200	8.920	78.026	70.089	25.398	70.583	21.797	-1.489
3300	8.922	78.301	70.334	26.290	69.993	20.278	-1.343
3400	8.923	78.567	70.572	27.182	69.399	18.783	-1.207
3500	8.924	78.826	70.804	28.074	68.805	17.303	-1.080
3600	8.925	79.077	71.031	28.967	68.208	15.840	-0.962
3700	8.926	79.322	71.251	29.859	67.610	14.396	-0.850
3800	8.927	79.560	71.467	30.752	67.010	12.964	-0.746
3900	8.928	79.791	71.677	31.645	66.409	11.552	-0.647
3995.89	8.928	80.008	71.875	32.502	65.826	10.206	-0.558
3995.89	8.928	80.008	71.875	32.502	-52.319	10.206	-0.558
4000	8.928	80.017	71.883	32.538	-52.327	10.258	-0.560
4100	8.929	80.238	72.084	33.430	-52.610	11.824	-0.630
4200	8.930	80.453	72.281	34.323	-52.895	13.405	-0.697
4300	8.930	80.663	72.473	35.216	-53.184	14.990	-0.762
4400	8.931	80.869	72.662	36.109	-53.477	16.574	-0.823
4500	8.931	81.069	72.846	37.003	-53.771	18.173	-0.883
4600	8.932	81.266	73.027	37.896	-54.071	19.777	-0.940
4700	8.932	81.458	73.205	38.789	-54.375	21.378	-0.994
4800	8.933	81.646	73.379	39.682	-54.683	22.998	-1.047
4900	8.933	81.830	73.549	40.575	-54.995	24.624	-1.098
5000	8.933	82.010	73.717	41.469	-55.313	26.250	-1.147
5100	8.934	82.187	73.881	42.362	-55.638	27.883	-1.195
5200	8.934	82.361	74.042	43.256	-55.969	29.531	-1.241
5300	8.935	82.531	74.201	44.149	-56.309	31.179	-1.286
5400	8.935	82.698	74.357	45.042	-56.658	32.829	-1.329
5500	8.935	82.862	74.510	45.936	-57.016	34.497	-1.371
5600	8.935	83.023	74.661	46.829	-57.390	36.155	-1.411
5700	8.936	83.181	74.809	47.723	-57.776	37.835	-1.451
5800	8.936	83.337	74.954	48.617	-58.180	39.520	-1.489
5900	8.936	83.489	75.098	49.510	-58.605	41.212	-1.527
6000	8.936	83.639	75.239	50.404	-59.054	42.908	-1.563

15 December 1962

RCF

RHODIUM MONOXIDE (RhO) (IDEAL MOLECULAR GAS) gfw = 118.91

$$\Delta H_{f0}^{\circ} = 88.691 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 88.400 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 4

$$S_{298.15}^{\circ} = 57.727 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.119 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	4	0	820	—	—	0.373	—	—	—

Heat of Formation

Estimated by analogy to data for RhO₂(g).

Heat Capacity and Entropy

Calculated using above estimated spectroscopic constants.

TABLE 185

SILICON MONOXIDE

IDEAL MOLECULAR GAS

OSi

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Si from 0° to 1690°K,
Liquid Si from 1690° to 3566°K, Gaseous Si from 3566° to 6000°K;
Gaseous O₂, Gaseous SiO.

T, °K	C_p°	C_p°	$(F_f^\circ - H_{f,298}^\circ)/T$	$H_f^\circ - H_{f,298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.083	-24.316	-24.316	INFINITE
298.15	7.146	50.544	50.544	0.000	-24.040	-30.453	22.322
300	7.151	50.588	50.544	0.013	-24.042	-30.493	22.213
400	7.442	52.684	50.828	0.742	-24.176	-32.624	17.824
500	7.736	54.377	51.374	1.502	-24.331	-34.719	15.175
600	7.983	55.810	51.997	2.288	-24.497	-36.781	13.397
700	8.178	57.056	52.632	3.096	-24.668	-38.814	12.118
800	8.329	58.158	53.256	3.922	-24.846	-40.824	11.152
900	8.447	59.146	53.856	4.761	-25.031	-42.810	10.395
1000	8.539	60.041	54.431	5.611	-25.224	-44.774	9.785
1100	8.613	60.859	54.978	6.468	-25.426	-46.719	9.282
1200	8.673	61.611	55.500	7.333	-25.634	-48.647	8.859
1300	8.723	62.307	55.997	8.203	-25.850	-50.555	8.499
1400	8.764	62.955	56.472	9.077	-26.075	-52.449	8.187
1500	8.799	63.561	56.924	9.955	-26.309	-54.323	7.914
1600	8.829	64.130	57.357	10.837	-26.551	-56.183	7.674
1690	8.853	64.614	57.731	11.633	-26.776	-57.845	7.480
1700	8.855	64.614	57.731	11.633	-26.776	-57.845	7.480
1800	8.878	65.173	58.169	12.408	-26.991	-59.497	7.250
1900	8.899	65.653	58.550	13.197	-27.201	-61.137	7.000
2000	8.918	66.110	58.917	14.000	-27.406	-62.760	6.723
2100	8.934	66.546	59.270	14.817	-27.606	-64.366	6.423
2200	8.950	66.962	59.610	15.647	-27.801	-65.955	6.100
2300	8.964	67.360	59.938	16.490	-27.991	-67.526	5.757
2400	8.977	67.742	60.256	17.347	-28.176	-69.079	5.400
2500	8.990	68.109	60.562	18.217	-28.356	-70.614	5.030
2600	9.001	68.462	60.860	19.100	-28.531	-72.131	4.647
2700	9.012	68.801	61.148	20.000	-28.701	-73.630	4.250
2800	9.023	69.129	61.427	20.917	-28.866	-75.111	3.840
2900	9.033	69.446	61.698	21.850	-29.026	-76.574	3.410
3000	9.043	69.753	61.961	22.800	-29.181	-78.020	2.960
3100	9.053	70.050	62.218	23.767	-29.331	-79.447	2.490
3200	9.063	70.337	62.467	24.750	-29.476	-80.855	2.000
3300	9.072	70.616	62.710	25.750	-29.616	-82.244	1.490
3400	9.082	70.887	62.946	26.767	-29.751	-83.614	0.960
3500	9.092	71.151	63.177	27.800	-29.881	-84.964	0.410
3565.77	9.099	71.320	63.326	28.850	-29.996	-86.294	0.000
3565.77	9.099	71.320	63.326	28.850	-29.996	-86.294	0.000
3600	9.102	71.407	63.402	28.818	-29.962	-86.328	0.034
3700	9.112	71.657	63.622	29.728	-30.134	-87.682	0.411
3800	9.123	71.900	63.837	30.660	-30.301	-89.011	0.800
3900	9.135	72.137	64.047	31.613	-30.463	-90.314	1.190
4000	9.147	72.369	64.252	32.587	-30.620	-91.591	1.580
4100	9.160	72.595	64.453	33.582	-30.772	-92.844	1.960
4200	9.174	72.816	64.650	34.599	-30.919	-94.074	2.330
4300	9.184	73.032	64.842	35.637	-31.061	-95.281	2.690
4400	9.205	73.244	65.031	36.697	-31.200	-96.464	3.040
4500	9.223	73.451	65.216	37.778	-31.334	-97.624	3.380
4600	9.242	73.654	65.397	38.880	-31.463	-98.761	3.710
4700	9.262	73.854	65.575	39.997	-31.587	-99.874	4.030
4800	9.284	74.049	65.750	41.130	-31.706	-100.964	4.340
4900	9.307	74.241	65.922	42.280	-31.820	-102.031	4.640
5000	9.333	74.429	66.090	43.447	-31.929	-103.074	4.930
5100	9.360	74.615	66.256	44.630	-32.034	-104.094	5.210
5200	9.389	74.797	66.419	45.828	-32.134	-105.091	5.480
5300	9.421	74.976	66.579	47.040	-32.229	-106.064	5.740
5400	9.454	75.153	66.736	48.267	-32.319	-107.014	6.000
5500	9.489	75.327	66.891	49.500	-32.404	-107.941	6.250
5600	9.527	75.499	67.043	50.750	-32.484	-108.844	6.500
5700	9.567	75.668	67.194	52.017	-32.559	-109.724	6.740
5800	9.608	75.835	67.342	53.290	-32.629	-110.581	6.980
5900	9.652	76.000	67.487	54.570	-32.694	-111.414	7.210
6000	9.699	76.164	67.631	55.850	-32.754	-112.224	7.440

15 June 1963

HLS

SILICON MONOXIDE (SiO)

(IDEAL MOLECULAR GAS)

gfw = 44.09

$\Delta H_{f0} = -24.316 \text{ kcal gfw}^{-1}$
 Ground State Configuration $1\Sigma^+$
 $H_{298.15} - H_0 = 2.083 \text{ kcal gfw}^{-1}$

$\Delta H_{f298.15}^\circ = -24.04 \text{ kcal gfw}^{-1}$

$S_{298.15}^\circ = 50.544 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$

State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$1\Sigma^+$	1	cm^{-1} 0.0	cm^{-1} 1241.44	cm^{-1} 5.92	cm^{-1} 0.0	cm^{-1} 0.72729	cm^{-1} 0.00508	cm^{-1} 0.0	cm^{-1} 1.02
$3\Pi_T$	6	32000	1000	6.0	0.0	0.67656	0.0	0.0	1.4

Heat of Formation

As interim measure, the value by Wise et al.¹ has been used. This value may be modified slightly by using internally self-consistent functions generated on this project.

Heat Capacity and Entropy

Have been calculated using ground-state data by Lagerqvist and Uhler² and excited state from Verma and Mulliken.³

References

1. Wise, S. S. et al, J. Phys. Chem. 67, 815 (1963).
2. Lagerqvist, A. and U. Uhler, Arkiv Physik 6, 95 (1953).
3. Verma, R. D. and R. S. Mulliken, Can. J. Phys. 39, 908 (1961).

SILICON MONOXIDE (SiO)

(IDEAL MOLECULAR GAS)

GFW = 44.09

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal °K gfw				Kcal/gfw		ΔF_f	Log K _p
	C_p	S_f°	$-(F_f^\circ - H_{298}^\circ)/T$	H_f°	H_{298}°	ΔH_f°		
298.15	± 0.005	± 0.005	± 0.005	± 0.000	± 0.000	± 0.450		
1000	± 0.005	± 0.006	± 0.005	± 0.005	± 0.005			
2000	± 0.008	± 0.008	± 0.006	± 0.010				
3000	± 0.010	± 0.010	± 0.008	± 0.020				
4000	± 0.040	± 0.012	± 0.009	± 0.030				
5000	± 0.200	± 0.035	± 0.015	± 0.130				
6000	± 0.700	± 0.110	± 0.025	± 0.500				

TABLE 186

STRONTIUM MONOXIDE

CONDENSED PHASE

OSr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Sr from 0° to 1045°K,
Liquid Sr from 1045° to 1641°K, Gaseous Sr from 1641° to 4000°K; Gaseous O₂;
Solid SrO from 0° to 2690°K, Liquid SrO from 2690° to 6000°K.

T, °K	C_p°	$\frac{\text{cal}}{^\circ\text{K gfw}}$ S_T°	$\frac{\text{cal}}{^\circ\text{K gfw}}$ $-(F_T - H_{298}^\circ)/T$	$\frac{\text{Kcal}}{\text{gfw}}$ $H_T^\circ - H_{298}^\circ$	$\frac{\text{Kcal}}{\text{gfw}}$ ΔH_f°	$\frac{\text{Kcal}}{\text{gfw}}$ ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.038	-140.551	-140.551	INFINITE
298.15	10.760	13.060	13.060	0.000	-141.100	-133.961	98.192
300	10.784	13.127	13.060	0.020	-141.099	-133.917	97.554
400	11.663	16.365	13.496	1.148	-140.987	-131.539	71.866
500	12.138	19.023	14.343	2.340	-140.860	-129.192	56.467
600	12.453	21.265	15.315	3.570	-140.749	-126.868	46.210
700	12.694	23.204	16.307	4.828	-140.661	-124.563	38.888
800	12.894	24.912	17.278	6.108	-140.600	-122.267	33.400
862	13.006	25.879	17.862	6.910	-140.578	-120.847	30.638
862	13.006	25.879	17.862	6.910	-140.578	-120.847	30.638
900	13.071	26.441	18.212	7.406	-140.786	-119.969	29.131
1000	13.233	27.827	19.106	8.721	-140.800	-117.655	25.712
1045	13.303	28.411	19.494	9.318	-140.804	-116.613	24.387
1045	13.303	28.411	19.494	9.318	-142.774	-116.613	24.387
1100	13.386	29.095	19.957	10.052	-142.701	-115.238	22.895
1200	13.532	30.266	20.768	11.398	-142.559	-112.748	20.533
1300	13.674	31.355	21.541	12.758	-142.447	-110.270	18.537
1400	13.813	32.374	22.279	14.133	-142.245	-107.805	16.828
1500	13.949	33.331	22.984	15.521	-142.072	-105.350	15.349
1600	14.083	34.236	23.659	16.923	-141.888	-102.907	14.056
1640.43	14.138	34.593	23.928	17.501	-141.802	-101.909	13.572
1640.43	14.138	34.593	23.928	17.501	-174.814	-101.909	13.572
1700	14.216	35.094	24.307	18.338	-174.531	-99.288	12.764
1800	14.348	35.910	24.929	19.766	-174.046	-94.877	11.519
1900	14.479	36.689	25.577	21.207	-173.552	-90.492	10.408
2000	14.609	37.435	26.104	22.662	-173.049	-86.133	9.412
2100	14.739	38.151	26.661	24.129	-172.539	-81.801	8.513
2200	14.868	38.840	27.199	25.609	-172.023	-77.490	7.698
2300	14.997	39.503	27.720	27.103	-171.502	-73.204	6.956
2400	15.125	40.144	28.224	28.609	-170.978	-68.943	6.278
2500	15.253	40.764	28.713	30.128	-170.452	-64.705	5.656
2600	15.381	41.365	29.189	31.659	-169.926	-60.482	5.084
2690	15.496	41.891	29.605	33.049	-169.456	-56.707	4.607
2690	17.000	47.876	29.605	49.149	-153.356	-56.707	4.607
2700	17.000	47.939	29.673	49.319	-153.289	-56.344	4.561
2800	17.000	48.557	30.336	51.019	-152.674	-52.766	4.118
2900	17.000	49.154	30.975	52.719	-151.984	-49.211	3.708
3000	17.000	49.730	31.590	54.419	-151.363	-45.675	3.327
3100	17.000	50.287	32.184	56.119	-150.774	-42.160	2.972
3200	17.000	50.827	32.759	57.819	-150.207	-38.669	2.641
3300	17.000	51.350	33.314	59.519	-149.669	-35.190	2.330
3400	17.000	51.858	33.852	61.219	-149.163	-31.731	2.040
3500	17.000	52.350	34.374	62.919	-148.689	-28.282	1.766
3600	17.000	52.829	34.880	64.619	-148.250	-24.850	1.508
3700	17.000	53.295	35.371	66.319	-147.847	-21.428	1.266
3800	17.000	53.749	35.849	68.019	-147.483	-18.012	1.036
3900	17.000	54.190	36.313	69.719	-147.157	-14.611	0.819
4000	17.000	54.621	36.766	71.419	-146.870	-11.217	0.613
4100	17.000	55.040	37.206	73.119	-146.624	-7.827	0.417
4200	17.000	55.450	37.636	74.819	-146.418	-4.444	0.231
4300	17.000	55.850	38.055	76.519	-146.252	-1.061	0.054
4400	17.000	56.241	38.464	78.219	-146.126	2.310	-0.115
4500	17.000	56.623	38.863	79.919	-146.039	5.685	-0.276
4600	17.000	56.996	39.253	81.619	-145.991	9.057	-0.430
4700	17.000	57.362	39.635	83.319	-145.983	12.427	-0.578
4800	17.000	57.720	40.008	85.019	-146.011	15.797	-0.719
4900	17.000	58.070	40.373	86.719	-146.076	19.168	-0.855
5000	17.000	58.414	40.730	88.419	-146.177	22.544	-0.985
5100	17.000	58.751	41.080	90.119	-146.314	25.919	-1.111
5200	17.000	59.081	41.423	91.819	-146.485	29.292	-1.231
5300	17.000	59.405	41.759	93.519	-146.691	32.682	-1.348
5400	17.000	59.722	42.089	95.219	-146.931	36.068	-1.460
5500	17.000	60.034	42.413	96.919	-147.203	39.459	-1.568
5600	17.000	60.341	42.730	98.619	-147.511	42.857	-1.672
5700	17.000	60.641	43.042	100.319	-147.853	46.267	-1.774
5800	17.000	60.937	43.348	102.019	-148.231	49.673	-1.872
5900	17.000	61.228	43.648	103.719	-148.646	53.097	-1.967
6000	17.000	61.513	43.944	105.419	-149.101	56.524	-2.059

15 December 1962

RCF

STRONTIUM MONOXIDE (SrO) (CONDENSED PHASE)

gfw = 103.63

$$\Delta H_{f298.15}^{\circ} = -141.100 \text{ kcal gfw}^{-1} \quad S_{298.15}^{\circ} = 13.060 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2690^{\circ}\text{K}$$

$$\Delta H_m = 16.1 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.038 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 12.13 + 1.26 \times 10^{-3}T - 1.55 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 2690^{\circ}\text{K}$$

$$C_p^{\circ} = 17.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2690^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

An f. c. c. (NaCl) type.

Heat of Formation

Based on data from Rossini et al.¹

Heat Capacity and Entropy

Low-temperature data by Anderson.² High-temperature data valid to 1266°K by Lander³ and Kelley⁴ extrapolated to melting point. Liquid heat capacity estimated.

Melting and Vaporization

Heat of fusion estimated. See Barriault et al.⁵ for details.

References

1. Rossini, F. et al., Nat. Bur. Stds. (U.S.) Circ. 500 (1952).
2. Anderson, C. T., J. Am. Chem. Soc. 57, 429 (1935).
3. Lander, J. J., J. Am. Chem. Soc. 73, 5794 (1951).
4. Kelley, K. K., U. S. Bur. Mines, Bull. 584 (1960).
5. Barriault, R. J. et al., ASD TR 61-260, Pt. I (May 1962).

STRONTIUM MONOXIDE (SrO)

(CONDENSED PHASE)

GFW = 103.63

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔI_f	Log K _p
298.15	± 0.200	± 0.200	± 0.200	± 0.000	± 2.000	± 2.210	± 1.620
1000	± 0.940	± 0.650	± 0.390	± 0.260	± 2.440	± 2.960	± 0.650
2000	± 1.780	± 0.940	± 0.600	± 0.680	± 3.730	± 4.250	± 0.460
2690	± 2.680	± 1.070	± 0.700	± 0.990	± 4.040	± 4.930	± 0.400
2690	± 1.000	± 1.590	± 0.700	± 2.390	± 5.440	± 4.930	± 0.400
4000	± 2.000	± 2.190	± 1.100	± 4.350	± 7.400	± 7.450	± 0.410

TABLE 187

STRONTIUM MONOXIDE

IDEAL MOLECULAR GAS

OSr

Reference State for Calculating ΔH_f° , ΔF_f° and $\log K_p$: Solid Sr from 0° to 1045°K.
 Liquid Sr from 1045° to 1641°K, Gaseous Sr from 1641° to 6000°K; Gaseous O₂; Gaseous SrO.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
°C	0.000	0.000	INFINITE	-2.161	-11.874	-11.874	INFINITE
298.15	7.910	57.145	57.145	0.000	-12.300	-18.305	13.417
300	7.918	57.194	57.145	0.015	-12.303	-18.342	13.362
400	8.277	59.525	57.460	0.826	-12.509	-20.325	11.104
500	8.501	61.338	58.067	1.666	-12.734	-22.254	9.727
600	8.644	62.961	58.756	2.523	-12.996	-24.133	8.790
700	8.742	64.302	59.454	3.393	-13.295	-25.966	8.107
800	8.813	65.474	60.135	4.271	-13.637	-27.753	7.581
862	8.848	66.133	60.543	4.818	-13.870	-28.838	7.311
862	8.848	66.133	60.543	4.818	-14.070	-28.838	7.311
900	8.866	65.515	60.787	5.155	-14.236	-29.486	7.160
1000	8.909	67.452	61.408	6.044	-14.677	-31.157	6.809
1045	8.925	67.844	61.676	6.445	-14.878	-31.894	6.670
1045	8.925	67.844	61.676	6.445	-16.848	-31.894	6.670
1100	8.944	68.302	61.996	6.936	-17.017	-32.681	6.493
1200	8.973	69.082	62.555	7.832	-17.325	-34.093	6.209
1300	9.000	69.801	63.085	8.731	-17.634	-35.477	5.964
1400	9.024	70.469	63.589	9.632	-17.946	-36.839	5.751
1500	9.046	71.093	64.069	10.536	-18.257	-38.177	5.562
1600	9.068	71.677	64.526	11.442	-18.569	-39.494	5.394
1640.43	9.077	71.707	64.708	11.813	-18.690	-40.029	5.331
1640.43	9.077	71.707	64.708	11.813	-51.702	-40.029	5.331
1700	9.089	72.228	64.963	12.349	-51.720	-39.604	5.091
1800	9.111	72.748	65.382	13.259	-51.753	-38.892	4.722
1900	9.132	73.242	65.753	14.172	-51.787	-38.177	4.391
2000	9.155	73.711	66.168	15.086	-51.825	-37.460	4.093
2100	9.177	74.156	66.538	16.002	-51.866	-36.743	3.824
2200	9.201	74.586	66.895	16.921	-51.912	-36.022	3.578
2300	9.224	74.996	67.238	17.843	-51.962	-35.297	3.354
2400	9.247	75.390	67.570	18.767	-52.020	-34.573	3.148
2500	9.276	75.768	67.891	19.693	-52.087	-33.849	2.959
2600	9.305	76.133	68.201	20.622	-52.164	-33.116	2.784
2690	9.331	76.451	68.473	21.461	-52.245	-32.460	2.637
2690	9.331	76.451	68.473	21.461	-52.245	-32.460	2.637
2700	9.334	76.485	68.502	21.554	-52.254	-32.384	2.621
2800	9.363	76.826	68.794	22.489	-52.358	-31.648	2.470
2900	9.392	77.156	69.077	23.427	-52.460	-30.908	2.329
3000	9.423	77.475	69.353	24.367	-52.621	-30.163	2.197
3100	9.454	77.785	69.620	25.311	-52.782	-29.410	2.073
3200	9.486	78.087	69.881	26.258	-52.968	-28.660	1.957
3300	9.518	78.380	70.135	27.208	-53.160	-27.899	1.848
3400	9.551	78.666	70.383	28.162	-53.420	-27.136	1.744
3500	9.585	78.944	70.624	29.119	-53.689	-26.358	1.646
3600	9.619	79.216	70.860	30.079	-53.990	-25.579	1.553
3700	9.653	79.481	71.091	31.042	-54.324	-24.791	1.464
3800	9.688	79.740	71.316	32.009	-54.692	-23.987	1.379
3900	9.724	79.993	71.537	32.980	-55.096	-23.183	1.299
4000	9.760	80.241	71.753	33.954	-55.535	-22.366	1.222
4100	9.796	80.484	71.964	34.931	-56.012	-21.533	1.148
4200	9.833	80.722	72.171	35.912	-56.525	-20.692	1.077
4300	9.870	80.955	72.375	36.897	-57.074	-19.838	1.008
4400	9.908	81.184	72.574	37.886	-57.659	-18.975	0.942
4500	9.946	81.409	72.769	38.878	-58.280	-18.192	0.879
4600	9.985	81.630	72.962	39.875	-58.935	-17.204	0.817
4700	10.024	81.847	73.150	40.875	-59.627	-16.295	0.758
4800	10.063	82.060	73.336	41.879	-60.351	-15.379	0.700
4900	10.103	82.270	73.518	42.887	-61.108	-14.444	0.644
5000	10.144	82.477	73.697	43.899	-61.897	-13.490	0.590
5100	10.184	82.681	73.874	44.915	-62.718	-12.530	0.537
5200	10.226	82.881	74.048	45.935	-63.569	-11.556	0.486
5300	10.267	83.079	74.219	46.959	-64.450	-10.554	0.435
5400	10.310	83.274	74.387	47.987	-65.363	-9.541	0.386
5500	10.352	83.466	74.553	49.020	-66.302	-8.513	0.338
5600	10.395	83.656	74.717	50.056	-67.274	-7.470	0.292
5700	10.439	83.843	74.878	51.097	-68.275	-6.400	0.245
5800	10.482	84.028	75.038	52.143	-69.307	-5.331	0.201
5900	10.526	84.210	75.195	53.193	-70.372	-4.229	0.157
6000	10.571	84.391	75.350	54.247	-71.473	-3.114	0.113

15 December 1962

RCF

STRONTIUM MONOXIDE (SrO) (IDEAL MOLECULAR GAS) gfw = 103.63

$$\Delta H_{f0}^0 = -11.874 \text{ kcal gfw}^{-1}$$

$$\Delta H_{(298.15)}^0 = -12.300 \text{ kcal gfw}^{-1}$$

Ground State Configuration = $^3\Sigma$

$$S_{298.15}^0 = 57.145 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^0 - H_0^0 = 2.161 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X $^3\Sigma$	3	0	653.47	3.95	—	0.3379	0.0021	—	0.42
A' $^1\Sigma$	1	10885	619.6	0.9	—	0.3047	0.0011	—	3.2
B' $^1\Sigma$	2	24004.0	520.0	3.5	—	0.2936	0.002	—	0.37
C' $^1\Sigma$	1	28546.4	480.2	2.6	—	0.2742	0.0021	—	0.35

Heat of Formation

Calculated from vapor-pressure data analyzed by Ackermann and Thorn,¹ based on work of Moore et al.²

Heat Capacity and Entropy

Calculated using above spectroscopic constants. See volume 1, this study (section IVB26.4) and Barriault et al.³ for details.

References

1. Ackermann, R. and R. Thorn, p. 50 of Prog. Ceramics Science, edited by J. E. Burke, Pergamon Press (1961).
2. Moore, G. E. et al., J. Chem. Phys. 18, 1572 (1950).
3. Barriault, R. et al., ASD TR 61-260, Pt. I (May 1962).

TABLE 188

TANTALUM MONOXIDE

IDEAL MOLECULAR GAS

OTa

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ta from 0° to 3270°K,
Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K; Gaseous O₂; Gaseous TaO.

T, °K	C_p	$\frac{cal}{^\circ K \text{ gfw}}$ $\frac{C_p}{T}$	$\frac{H_f^\circ - H_{298}^\circ}{T}$	$\frac{H_f^\circ - H_{298}^\circ}{T}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.258	52.110	52.110	INFINITE
298.15	7.954	58.568	58.568	0.000	51.973	44.774	-32.819
300	7.956	58.618	58.568	0.015	51.970	44.730	-32.584
400	8.116	60.927	58.882	0.818	51.799	42.341	-23.133
500	8.287	62.757	59.480	1.638	51.621	39.997	-17.482
600	8.431	64.281	60.157	2.474	51.437	37.690	-13.728
700	8.542	65.589	60.842	3.323	51.248	35.413	-11.056
800	8.628	66.736	61.508	4.182	51.052	33.165	-9.060
900	8.694	67.756	62.147	5.048	50.851	30.940	-7.513
1000	8.745	68.674	62.754	5.920	50.643	28.739	-6.281
1100	8.787	69.510	63.331	6.797	50.432	26.559	-5.277
1200	8.820	70.276	63.878	7.677	50.213	24.399	-4.443
1300	8.848	70.983	64.398	8.561	49.989	22.256	-3.741
1400	8.872	71.640	64.892	9.447	49.758	20.131	-3.143
1500	8.892	72.253	65.363	10.335	49.518	18.023	-2.626
1600	8.910	72.827	65.811	11.225	49.271	15.932	-2.176
1700	8.925	73.368	66.240	12.117	49.015	13.856	-1.781
1800	8.939	73.878	66.650	13.010	48.749	11.796	-1.432
1900	8.952	74.367	67.044	13.905	48.474	9.748	-1.121
2000	8.964	74.822	67.421	14.801	48.185	7.719	-0.843
2100	8.974	75.259	67.784	15.697	47.882	5.703	-0.593
2200	8.984	75.677	68.134	16.595	47.566	3.702	-0.368
2300	8.994	76.077	68.470	17.494	47.233	1.717	-0.163
2400	9.003	76.460	68.795	18.394	46.882	-0.257	0.023
2500	9.012	76.827	69.109	19.295	46.505	-2.213	0.193
2600	9.020	77.181	69.413	20.197	46.108	-4.154	0.349
2700	9.029	77.522	69.707	21.099	45.674	-6.078	0.492
2800	9.037	77.850	69.992	22.002	45.199	-7.989	0.624
2900	9.045	78.168	70.269	22.906	44.671	-9.880	0.745
3000	9.054	78.474	70.537	23.811	44.080	-11.751	0.856
3100	9.063	78.772	70.798	24.717	43.419	-13.600	0.959
3200	9.072	79.060	71.052	25.624	42.679	-15.430	1.054
3270	9.079	79.256	71.226	26.259	42.111	-16.695	1.116
3270	9.079	79.256	71.226	26.259	42.111	-16.695	1.116
3300	9.081	79.339	71.299	26.532	41.511	-17.172	1.137
3400	9.091	79.610	71.540	27.440	40.857	-18.759	1.206
3500	9.102	79.874	71.774	28.350	40.140	-20.325	1.269
3600	9.113	80.131	72.003	29.261	39.362	-21.886	1.329
3700	9.125	80.381	72.226	30.173	38.514	-23.433	1.384
3800	9.138	80.625	72.444	31.086	37.594	-24.967	1.436
3900	9.152	80.862	72.657	32.000	36.604	-26.493	1.485
4000	9.166	81.094	72.865	32.915	35.544	-28.005	1.530
4100	9.182	81.321	73.069	33.834	34.414	-29.510	1.573
4200	9.199	81.543	73.268	34.753	33.214	-30.998	1.613
4300	9.216	81.760	73.464	35.673	31.944	-32.483	1.651
4400	9.235	81.972	73.655	36.596	30.604	-33.955	1.686
4500	9.255	82.180	73.842	37.520	29.194	-35.417	1.720
4600	9.276	82.384	74.026	38.447	27.714	-36.867	1.751
4700	9.298	82.584	74.206	39.376	26.164	-38.309	1.781
4800	9.321	82.780	74.383	40.307	24.544	-39.743	1.809
4900	9.346	82.973	74.557	41.240	22.864	-41.174	1.836
5000	9.371	83.162	74.727	42.176	21.114	-42.587	1.861
5100	9.397	83.348	74.895	43.114	19.304	-43.994	1.885
5200	9.425	83.532	75.059	44.055	17.434	-45.392	1.908
5300	9.454	83.712	75.221	45.000	15.504	-46.785	1.929
5400	9.483	83.889	75.381	45.946	13.514	-48.170	1.949
5500	9.514	84.064	75.537	46.896	11.464	-49.538	1.968
5600	9.545	84.236	75.692	47.849	9.354	-50.907	1.987
5700	9.577	84.406	75.843	48.805	7.184	-52.263	2.004
5706.65	9.580	84.417	75.853	48.869	6.886	-52.353	2.005
5706.65	9.580	84.417	75.853	48.869	-156.436	-52.353	2.005
5800	9.611	84.573	75.993	49.764	-157.041	-50.649	1.908
5900	9.644	84.738	76.140	50.727	-157.707	-48.811	1.808
6000	9.679	84.901	76.285	51.693	-158.394	-46.955	1.710

15 September 1963

HLS

TANTALUM MONOXIDE (TaO) (IDEAL MOLECULAR GAS) gfw = 196.95

$$\Delta H_{f0}^{\circ} = 52.110 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 51.973 \text{ kcal gfw}^{-1}$$

Ground State Configuration 2Δ

$$S_{298.15}^{\circ} = 58.568 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.258 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	a_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
a $\left\{ \begin{array}{l} 2 \Delta_{3/2} \\ 2 \Delta_{5/2} \end{array} \right\}$	2	0	1013.17	5.0	0.0	0.4029	0.002	0.0	0.0
	2	300.							
b $\left\{ \begin{array}{l} 2 \pi_{1/2} \\ 2 \pi_{3/2} \end{array} \right\}$	2	23348	896.	4.1	0.0	0.3772	0.0019	0.0	0.0
	2	24364							
c $\left\{ \begin{array}{l} 2 \Delta \end{array} \right\}$	4	26679	903.01	4.15	0.0	0.3775	0.0019	0.0	0.0

Heat of Formation

Vaporization data reported by Inghram et al¹ were analyzed.

Heat Capacity and Entropy

Calculated using spectroscopic constants above, based primarily on the work of Premaswarup and Barrow.²

References

1. Inghram, M. G., et al, J. Chem. Phys. 27, 569 (1957).
2. Premaswarup, D. and R. F. Barrow, Nature 180, 602 (1957).

TANTALUM MONOXIDE (TaO) (IDEAL MOLECULAR GAS) GFW = 196.95

SUMMARY OF UNCERTAINTY ESTIMATES

T °K	C_p	C_v	$(E_T - H_{298}) T$	$H_T - H_{298}$	ΔH_f	ΔG_f	Log K _p
298.15	±1.000	±1.000	±1.000	±0.000	±5.000		
1000	±1.000	±2.210	±1.508	±0.702			
2000	±1.000	±2.903	±2.052	±1.702			
3000	±1.000	±3.309	±2.408	±2.702			
4000	±1.000	±3.596	±2.671	±3.702			
5000	±1.000	±3.820	±2.879	±4.702			
6000	±1.000	±4.002	±3.052	±5.702			

TABLE 182

TECHNETIUM MONOXIDE

IDEAL MOLECULAR GAS

OTc

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Tc from 0° to 2473°K, Liquid Tc from 2473° to 4840°K, Gaseous Tc from 4840° to 6000°K; Gaseous O₂; Gaseous TcO.

T, °K	C_p	S_T	$-(F_T - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.114	89.004	89.004	INFINITE
298.15	7.521	57.538	57.538	0.000	88.600	81.136	-59.471
300	7.529	57.584	57.538	0.014	88.597	81.090	-59.071
400	7.911	59.805	57.838	0.787	88.425	78.614	-42.950
500	8.185	61.602	58.417	1.592	88.253	76.181	-33.297
600	8.373	63.112	59.077	2.421	88.074	73.783	-26.874
700	8.502	64.413	59.748	3.265	87.880	71.416	-22.296
800	8.594	65.554	60.404	4.120	87.664	69.079	-18.871
900	8.661	66.571	61.034	4.983	87.431	66.769	-16.213
1000	8.710	67.486	61.634	5.852	87.175	64.488	-14.093
1100	8.748	68.318	62.204	6.725	86.898	62.232	-12.364
1200	8.778	69.080	62.746	7.601	86.600	60.002	-10.927
1300	8.801	69.784	63.261	8.480	86.280	57.798	-9.716
1400	8.820	70.437	63.750	9.361	85.939	55.620	-8.682
1500	8.835	71.046	64.217	10.244	85.576	53.466	-7.790
1600	8.848	71.617	64.662	11.128	85.191	51.338	-7.012
1700	8.858	72.153	65.087	12.013	84.784	49.235	-6.329
1800	8.867	72.660	65.493	12.900	84.356	47.158	-5.725
1900	8.875	73.140	65.883	13.787	83.90	45.102	-5.188
2000	8.881	73.595	66.258	14.675	83.433	43.072	-4.706
2100	8.887	74.028	66.617	15.563	82.938	41.068	-4.274
2200	8.892	74.442	66.964	16.452	82.422	39.084	-3.882
2300	8.896	74.837	67.298	17.341	81.881	37.125	-3.527
2400	8.900	75.216	67.620	18.231	81.320	35.192	-3.204
2473	8.902	75.483	67.848	18.881	80.896	33.796	-2.987
2473	8.907	75.483	67.848	18.881	75.208	33.796	-2.987
2500	8.903	75.579	67.931	19.121	75.053	33.344	-2.915
2600	8.906	75.929	68.232	20.012	74.478	31.687	-2.663
2700	8.909	76.265	68.523	20.903	73.900	30.052	-2.432
2800	8.911	76.585	68.805	21.794	73.320	28.439	-2.220
2900	8.913	76.907	69.079	22.685	72.737	26.846	-2.023
3000	8.915	77.204	69.345	23.576	72.152	25.275	-1.841
3100	8.917	77.496	69.603	24.468	71.565	23.722	-1.672
3200	8.918	77.774	69.854	25.360	70.976	22.189	-1.515
3300	8.920	78.054	70.099	26.251	70.385	20.670	-1.369
3400	8.921	78.320	70.337	27.144	69.793	19.174	-1.232
3500	8.922	78.579	70.568	28.036	69.198	17.699	-1.105
3600	8.923	78.830	70.794	28.928	68.601	16.235	-0.986
3700	8.925	79.074	71.015	29.820	68.002	14.785	-0.873
3800	8.925	79.312	71.230	30.713	67.403	13.358	-0.768
3900	8.926	79.544	71.440	31.605	66.800	11.944	-0.669
4000	8.927	79.770	71.646	32.498	66.197	10.542	-0.576
4100	8.928	79.991	71.847	33.391	65.592	9.158	-0.488
4200	8.929	80.206	72.043	34.284	64.985	7.792	-0.405
4300	8.929	80.416	72.235	35.177	64.377	6.440	-0.327
4400	8.930	80.621	72.424	36.070	63.766	5.097	-0.254
4500	8.930	80.822	72.608	36.963	63.153	3.770	-0.183
4600	8.931	81.018	72.789	37.856	62.538	2.456	-0.117
4700	8.931	81.210	72.966	38.749	61.921	1.161	-0.054
4800	8.932	81.398	73.140	39.642	61.300	-0.126	0.006
4840.07	8.932	81.472	73.208	39.999	61.350	-0.640	0.029
4840.07	8.932	81.472	73.208	39.999	-78.342	-0.640	0.029
4900	8.932	81.583	73.310	40.535	-79.045	0.319	-0.015
5000	8.933	81.763	73.477	41.428	-79.426	1.011	-0.086
5100	8.933	81.940	73.642	42.321	-79.815	3.588	-0.154
5200	8.933	82.113	73.803	43.215	-80.213	5.234	-0.220
5300	8.934	82.284	73.961	44.108	-80.621	6.877	-0.284
5400	8.934	82.451	74.111	45.002	-81.039	8.534	-0.345
5500	8.934	82.614	74.270	45.895	-81.469	10.200	-0.405
5600	8.935	82.774	74.420	46.789	-81.912	11.877	-0.464
5700	8.935	82.934	74.568	47.682	-82.371	13.554	-0.520
5800	8.935	83.089	74.714	48.576	-82.848	15.239	-0.574
5900	8.936	83.242	74.857	49.469	-83.346	16.939	-0.627
6000	8.936	83.392	74.998	50.363	-83.868	18.646	-0.679

15 December 1962

RCF

TECHNETIUM MONOXIDE (TcO) (IDEAL MOLECULAR GAS) gfw = 115

$$\Delta H_{f0}^{\circ} = 89.004 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 88.600 \text{ kcal gfw}^{-1}$$

Ground State Degeneracy = 4

$$S_{298.15}^{\circ} = 57.538 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.114 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X	4	0	854	---	---	0.385	---	---	---

Heat of Formation

Estimated by comparison of dissociation energies of oxides of neighboring elements in periodic table.

Heat Capacity and Entropy

Calculated using above estimated spectroscopic constants.

TABLE 190

THORIUM MONOXIDE

IDEAL MOLECULAR GAS

OTh

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Th from 0° to 2028°K, Liquid Th from 2028° to 5060°K, Gaseous Th from 5060° to 6000°K, Gaseous O₂: Gaseous ThO.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.125	-7.172	-7.172	INFINITE
298.15	7.627	58.836	58.836	0.000	-7.640	-14.399	10.554
300	7.636	58.883	58.836	0.014	-7.649	-14.441	10.520
400	8.033	61.137	59.141	0.798	-8.084	-16.639	9.091
500	8.340	62.963	59.728	1.618	-8.493	-18.730	8.186
600	8.602	64.508	60.399	2.465	-8.888	-20.739	7.554
700	8.851	65.852	61.084	3.338	-9.268	-22.684	7.082
800	9.095	67.050	61.756	4.235	-9.634	-24.576	6.713
900	9.331	68.135	62.406	5.156	-9.984	-26.423	6.416
1000	9.551	69.130	63.029	6.101	-10.317	-28.231	6.169
1100	9.750	70.050	63.626	7.066	-10.635	-30.007	5.962
1200	9.923	70.906	64.198	8.050	-10.939	-31.755	5.783
1300	10.067	71.706	64.745	9.050	-11.232	-33.478	5.628
1400	10.183	72.456	65.269	10.062	-11.516	-35.178	5.491
1500	10.273	73.162	65.772	11.085	-11.792	-36.859	5.370
1600	10.338	73.827	66.255	12.116	-12.063	-38.521	5.261
1633	10.354	74.039	66.410	12.457	-12.152	-39.066	5.228
1633	10.354	74.039	66.410	12.457	-12.406	-39.066	5.228
1700	10.382	74.456	66.719	13.152	-13.144	-40.137	5.160
1800	10.408	75.050	67.166	14.192	-13.648	-41.711	5.064
1900	10.419	75.613	67.595	15.233	-14.154	-43.255	4.975
2000	10.418	76.147	68.010	16.275	-14.662	-44.774	4.892
2028	10.417	76.292	68.123	16.567	-14.805	-45.195	4.870
2028	10.417	76.292	68.123	16.567	-18.658	-45.195	4.870
2100	10.408	76.656	68.410	17.317	-19.026	-46.130	4.801
2200	10.391	77.140	68.796	18.357	-19.542	-47.408	4.709
2300	10.368	77.601	69.169	19.395	-20.062	-48.664	4.624
2400	10.342	78.042	69.529	20.430	-20.588	-49.896	4.543
2500	10.312	78.464	69.879	21.463	-21.119	-51.109	4.468
2600	10.281	78.868	70.217	22.493	-21.655	-52.296	4.396
2700	10.249	79.255	70.544	23.519	-22.197	-53.466	4.328
2800	10.217	79.628	70.862	24.542	-22.745	-54.613	4.263
2900	10.186	79.986	71.171	25.563	-23.299	-55.744	4.201
3000	10.154	80.331	71.471	26.580	-23.858	-56.854	4.142
3100	10.124	80.664	71.762	27.594	-24.422	-57.942	4.085
3200	10.095	80.985	72.046	28.604	-24.973	-59.018	4.031
3300	10.067	81.295	72.322	29.613	-25.521	-60.074	3.978
3400	10.040	81.596	72.590	30.618	-26.066	-61.107	3.928
3500	10.015	81.887	72.852	31.621	-26.611	-62.130	3.879
3600	9.991	82.169	73.107	32.621	-27.157	-63.132	3.832
3700	9.969	82.443	73.356	33.619	-27.702	-64.121	3.787
3800	9.948	82.709	73.599	34.615	-28.249	-65.094	3.744
3900	9.928	82.967	73.837	35.609	-28.799	-66.052	3.701
4000	9.910	83.219	74.069	36.600	-29.344	-66.994	3.660
4100	9.893	83.464	74.295	37.591	-30.321	-67.918	3.620
4200	9.877	83.702	74.517	38.579	-30.933	-68.830	3.581
4300	9.862	83.935	74.734	39.566	-31.544	-69.728	3.544
4400	9.849	84.162	74.956	40.552	-32.166	-70.652	3.509
4500	9.836	84.384	75.154	41.536	-32.787	-71.477	3.471
4600	9.825	84.601	75.357	42.519	-33.412	-72.330	3.436
4700	9.815	84.813	75.557	43.501	-34.041	-73.177	3.403
4800	9.805	85.020	75.753	44.482	-34.673	-74.002	3.369
4900	9.797	85.223	75.945	45.462	-35.309	-74.817	3.337
5000	9.790	85.421	76.133	46.441	-35.951	-75.620	3.305
5060.26	9.785	85.538	76.244	47.029	-36.341	-76.092	3.286
5060.26	9.785	85.538	76.244	47.029	-159.106	-76.092	3.286
5100	9.783	85.616	76.318	47.420	-159.296	-75.450	3.233
5200	9.777	85.806	76.499	48.398	-159.785	-73.805	3.102
5300	9.772	85.993	76.677	49.375	-160.286	-72.144	2.975
5400	9.767	86.177	76.852	50.352	-160.798	-70.480	2.852
5500	9.763	86.357	77.025	51.329	-161.321	-68.814	2.734
5600	9.760	86.534	77.194	52.305	-161.860	-67.126	2.620
5700	9.758	86.708	77.360	53.281	-162.414	-65.432	2.509
5800	9.756	86.878	77.524	54.257	-162.986	-63.729	2.401
5900	9.755	87.046	77.685	55.232	-163.580	-62.014	2.297
6000	9.754	87.211	77.843	56.207	-164.198	-60.290	2.196

15 December 1962

RCF

THORIUM MONOXIDE (ThO) (IDEAL MOLECULAR GAS) gfw = 248.05

$$\Delta H_{f0}^{\circ} = -7.172 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -7.640 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^3\Pi_0$$

$$S_{298.15}^{\circ} = 58.836 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.125 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$X^3\Pi$	2	0							
	2	2721	800	3.5	—	0.327	0.0018	—	0.22
	2	4177							

Heat of Formation

Calculated from data of Darnell et al.¹

Heat Capacity and Entropy

Calculated using spectroscopic constants above, which are based on Krishnamurty experimental data² and data estimated here.

References

1. Darnell, A. J. et al., J. Phys. Chem. 64, 341 (1960).
2. Krishnamurty, S. G., Proc. Phys. Soc. (London) 64A, 852 (1951).

TABLE 191

TITANIUM MONOXIDE

CONDENSED PHASE

OTI

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
 Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K; Gaseous O₂;
 Solid TiO from 0° to 2010°K, Liquid TiO from 2010° to 6000°K.

T, °K	C_p°	S_T°	$\frac{\text{cal/}^\circ\text{K gfw}}{-(F_T - H_{298})/T}$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.473	-123.436	-123.436	INFINITE
298.15	9.551	9.990	9.990	0.000	-124.150	-117.637	86.226
300	9.583	10.049	9.970	0.018	-124.149	-117.597	85.665
400	10.847	12.998	10.384	1.046	-124.096	-115.419	63.059
500	11.626	15.507	11.164	2.177	-123.985	-113.261	49.504
600	12.213	17.681	12.073	3.365	-123.843	-111.129	40.477
700	12.710	19.602	13.014	4.611	-123.679	-109.023	34.037
800	13.159	21.379	13.947	5.905	-123.494	-106.942	29.214
900	13.580	22.903	14.856	7.242	-123.289	-104.884	25.468
1000	13.984	24.355	15.734	8.621	-123.064	-102.850	22.477
1100	14.376	25.706	16.580	10.039	-122.820	-100.842	20.034
1155	14.589	26.413	17.031	10.835	-122.676	-99.745	18.873
1155	14.589	26.413	17.031	10.835	-123.626	-99.745	18.873
1200	14.761	26.974	17.394	11.496	-123.503	-98.817	17.996
1264	15.004	27.747	17.899	12.448	-123.320	-97.506	16.858
1264	15.642	28.346	17.859	13.268	-122.500	-97.506	16.858
1300	15.750	28.836	18.195	13.833	-122.372	-96.796	16.272
1400	16.050	30.014	18.998	15.423	-121.004	-94.842	14.805
1500	16.350	31.132	19.770	17.043	-121.619	-92.916	13.537
1600	16.650	32.197	20.514	18.693	-121.219	-91.016	12.432
1700	16.950	33.215	21.231	20.373	-120.801	-89.140	11.459
1800	17.250	34.193	21.924	22.083	-120.367	-87.290	10.598
1900	17.550	35.133	22.595	23.823	-119.915	-85.465	9.830
1950	17.700	35.591	22.922	24.704	-119.682	-84.560	9.477
1950	17.700	35.591	22.922	24.704	-123.382	-84.560	9.477
2000	17.850	36.041	23.244	25.593	-123.120	-83.568	9.131
2010	17.880	36.130	23.308	25.772	-123.066	-83.370	9.065
2010	14.500	43.095	23.308	39.772	-109.066	-83.370	9.065
2100	14.500	43.731	24.170	41.077	-108.889	-82.225	8.557
2200	14.500	44.405	25.075	42.527	-108.694	-80.961	8.042
2300	14.500	45.050	25.929	43.977	-108.502	-79.704	7.573
2400	14.500	45.667	26.739	45.427	-108.313	-78.455	7.144
2500	14.500	46.259	27.508	46.877	-108.127	-77.216	6.750
2600	14.500	46.827	28.240	48.327	-107.943	-75.981	6.386
2700	14.500	47.375	28.949	49.777	-107.762	-74.758	6.051
2800	14.500	47.902	29.627	51.227	-107.583	-73.537	5.740
2900	14.500	48.411	30.246	52.677	-107.407	-72.323	5.450
3000	14.500	48.902	30.860	54.127	-107.233	-71.117	5.181
3100	14.500	49.378	31.450	55.577	-107.061	-69.917	4.929
3200	14.500	49.838	32.017	57.027	-106.893	-68.721	4.693
3300	14.500	50.284	32.564	58.477	-106.725	-67.529	4.472
3400	14.500	50.717	33.092	59.927	-106.560	-66.345	4.264
3500	14.500	51.137	33.601	61.377	-106.397	-65.163	4.069
3550	14.500	51.343	33.850	62.102	-106.316	-64.577	3.975
3550	14.500	51.343	33.850	62.102	-208.773	-64.577	3.975
3600	14.500	51.546	34.094	62.827	-208.698	-62.545	3.797
3700	14.500	51.943	34.571	64.277	-208.559	-58.486	3.454
3800	14.500	52.330	35.033	65.727	-208.435	-54.430	3.130
3900	14.500	52.707	35.482	67.177	-208.324	-50.383	2.823
4000	14.500	53.074	35.917	68.627	-208.234	-46.332	2.531
4100	14.500	53.432	36.340	70.077	-208.155	-42.285	2.254
4200	14.500	53.781	36.751	71.527	-208.080	-38.239	1.990
4300	14.500	54.122	37.151	72.977	-208.038	-34.194	1.738
4400	14.500	54.456	37.540	74.427	-208.000	-30.148	1.497
4500	14.500	54.782	37.920	75.877	-207.975	-26.113	1.268
4600	14.500	55.100	38.290	77.327	-207.962	-22.067	1.048
4700	14.500	55.412	38.651	78.777	-207.962	-18.029	0.838
4800	14.500	55.717	39.003	80.227	-207.975	-13.983	0.637
4900	14.500	56.016	39.348	81.677	-207.999	-9.943	0.443
5000	14.500	56.309	39.684	83.127	-208.036	-5.900	0.258
5100	14.500	56.596	40.013	84.577	-208.086	-1.857	0.080
5200	14.500	56.878	40.334	86.027	-208.148	2.189	-0.092
5300	14.500	57.154	40.649	87.477	-208.221	6.238	-0.257
5400	14.500	57.425	40.957	88.927	-208.313	10.283	-0.416
5500	14.500	57.691	41.259	90.377	-208.418	14.337	-0.570
5600	14.500	57.953	41.555	91.827	-208.539	18.384	-0.717
5700	14.500	58.209	41.845	93.277	-208.678	22.443	-0.860
5800	14.500	58.461	42.129	94.727	-208.838	26.502	-0.999
5900	14.500	58.709	42.408	96.177	-209.021	30.566	-1.132
6000	14.500	58.953	42.682	97.627	-209.229	34.628	-1.261

31 December 1963

HLS

TITANIUM MONOXIDE (TiO) (CONDENSED PHASE) gfw = 63.90

$\Delta H_{f298.15}^{\circ} = -124.15 \text{ kcal gfw}^{-1}$	$S_{298.15}^{\circ} = 9.99 \text{ cal degK}^{-1} \text{ gfw}^{-1}$
$T_t = 1264^{\circ}\text{K}$	$\Delta H_t = 0.820 \text{ kcal gfw}^{-1}$
$T_m = 2010^{\circ}\text{K}$	$\Delta H_m = 14.0 \text{ kcal gfw}^{-1}$
$H_{298.15}^{\circ} - H_0^{\circ} = 1.473 \text{ kcal gfw}^{-1}$	
$C_p^{\circ} = 10.57 + 3.60 \times 10^{-3}T - 1.86 \times 10^{-5}T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1}$	$298.15^{\circ}\text{K} \leq T \leq 1264^{\circ}\text{K}$
$C_p^{\circ} = 11.85 + 3.0 \times 10^{-3}T \text{ cal degK}^{-1} \text{ gfw}^{-1}$	$1264^{\circ}\text{K} \leq T \leq 2010^{\circ}\text{K}$
$C_p^{\circ} = 14.5 \text{ cal degK}^{-1} \text{ gfw}^{-1}$	$2010^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$

Structure

TiO has an f. c. c. NaCl (B1) type structure with random vacancies of titanium and oxygen lattices.

Heat of Formation

Based on combustion calorimetry of Mah et al.¹

Heat Capacity and Entropy

Low-temperature data measured by Shomate.² An additional entropy contribution of 1.68 e. u. added to account for random vacant Ti and O vacancies as noted by Hoch et al.³ High-temperature data of Naylor⁴ valid to 1800°K extrapolated to melting point. Other data estimated.

Melting and Vaporization

Melting point from Brewer.⁵ Heat of fusion estimated by Kubaschewski and Evans.⁶

References

1. Mah, A. D. et al., U. S. Bur. of Mines, Rept. 5316 (1957).
2. Shomate, C., J. Am. Chem. Soc. 68, 310 (1946).
3. Hoch, M. et al., J. Phys. Chem. Solids 23, 1463 (1962).
4. Naylor, B. F., J. Am. Chem. Soc. 68, 1077 (1946).
5. Brewer, L., Chem. Revs. 52, 1-75 (1953).
6. Kubaschewski, O. and E. Evans, Metallurgical Thermochemistry, Pergamon Press, New York (1958).

TITANIUM MONOXIDE (TiO)

(CONDENSED PHASE)

GFW = 63.90

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	$\text{cal/}^{\circ}\text{K gfw}^{-1}$			Kcal/gfw^{-1}			Log K _p
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	± 0.300	± 0.500	± 0.500	± 0.000	± 1.000		
1000	± 0.300	± 0.863	± 0.652	± 0.211			
1264	± 0.300	± 0.933	± 0.704	± 0.290			
1264	± 1.000	± 1.012	± 0.704	± 0.390			
2000	± 1.000	± 1.471	± 0.908	± 1.126			
2010	± 1.000	± 1.476	± 0.911	± 1.136			
2010	± 2.000	± 3.466	± 0.911	± 5.136			
3000	± 2.000	± 4.267	± 1.895	± 7.116			
4000	± 2.000	± 4.843	± 2.564	± 9.116			
5000	± 2.000	± 5.289	± 3.066	± 11.116			
6000	± 2.000	± 5.654	± 3.468	± 13.116			

TITANIUM MONOXIDE

TABLE 192
IDEAL MOLECULAR GAS

OTI

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K,
Gaseous O₂, Gaseous TiO.

T, °K	C_p°	$\frac{C_p^\circ}{T}$	$-\frac{(F_f^\circ - H_{f,298}^\circ)/T}{T}$	$H_f^\circ - H_{f,298}^\circ$	Kcal/gm ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.491	12.496	12.496	INFINITE
298.15	7.814	55.989	55.989	0.000	13.000	5.798	-4.250
300	7.821	56.037	55.989	0.014	12.996	5.753	-4.191
400	8.144	58.333	56.300	0.813	12.420	3.365	-1.838
500	8.405	60.179	56.897	1.641	12.634	1.023	-0.447
600	8.595	61.730	57.577	2.492	12.434	-1.281	0.467
700	8.730	63.065	58.268	3.358	12.217	-3.551	1.109
800	8.825	64.238	58.942	4.236	11.986	-5.788	1.581
900	8.893	65.281	59.589	5.122	11.740	-7.994	1.941
1000	8.941	66.221	60.206	6.014	11.478	-10.172	2.223
1100	8.977	67.075	60.793	6.910	11.201	-12.326	2.449
1155	8.992	67.513	61.102	7.404	11.042	-13.497	2.554
1155	8.992	67.513	61.102	7.404	10.092	-13.497	2.554
1200	9.003	67.857	61.349	7.809	9.960	-14.413	2.625
1300	9.022	68.578	61.878	8.711	9.656	-16.434	2.763
1400	9.038	69.248	62.381	9.614	9.336	-18.429	2.877
1500	9.050	69.872	62.859	10.518	9.05	-20.400	2.972
1600	9.061	70.456	63.316	11.424	8.662	-22.350	3.053
1700	9.070	71.006	63.753	12.330	8.306	-24.278	3.121
1800	9.079	71.524	64.170	13.238	7.938	-26.183	3.179
1900	9.088	72.016	64.570	14.146	7.558	-28.068	3.228
1950	9.092	72.252	64.764	14.601	7.364	-29.002	3.250
1950	9.092	72.252	64.764	14.601	3.665	-29.002	3.250
2000	9.097	72.482	64.954	15.055	3.492	-29.838	3.260
2100	9.106	72.926	65.323	15.966	3.150	-31.496	3.278
2200	9.115	73.350	65.679	16.877	2.805	-33.139	3.292
2300	9.125	73.755	66.021	17.789	2.459	-34.765	3.303
2400	9.135	74.144	66.352	18.702	2.112	-36.376	3.312
2500	9.146	74.517	66.671	19.616	1.761	-37.974	3.320
2600	9.157	74.876	66.980	20.531	1.410	-39.555	3.325
2700	9.169	75.222	67.279	21.447	1.057	-41.126	3.329
2800	9.180	75.556	67.568	22.364	0.703	-42.678	3.331
2900	9.193	75.878	67.849	23.283	0.349	-44.221	3.332
3000	9.205	76.190	68.122	24.203	-0.008	-45.753	3.333
3100	9.217	76.492	68.388	25.124	-0.361	-47.275	3.333
3200	9.230	76.785	68.646	26.046	-0.724	-48.784	3.332
3300	9.243	77.069	68.897	26.970	-1.085	-50.277	3.330
3400	9.255	77.346	69.141	27.895	-1.442	-51.761	3.327
3500	9.268	77.614	69.380	28.821	-1.804	-53.239	3.324
3550	9.274	77.746	69.497	29.285	-1.984	-53.974	3.323
3550	9.274	77.746	69.497	29.285	-104.440	-53.974	3.323
3600	9.281	77.876	69.612	29.749	-104.626	-55.260	3.253
3700	9.293	78.130	69.839	30.677	-105.009	-56.828	3.061
3800	9.306	78.378	70.061	31.607	-105.405	-58.386	2.898
3900	9.318	78.620	70.277	32.538	-105.817	-60.934	2.742
4000	9.330	78.857	70.489	33.471	-106.240	-63.470	2.594
4100	9.342	79.087	70.696	34.404	-106.678	-65.995	2.452
4200	9.354	79.313	70.899	35.339	-107.128	-68.511	2.316
4300	9.365	79.533	71.097	36.275	-107.590	-71.012	2.186
4400	9.376	79.749	71.292	37.212	-108.065	-73.507	2.062
4500	9.387	79.960	71.482	38.150	-108.552	-75.992	1.942
4600	9.398	80.167	71.669	39.090	-109.049	-78.460	1.827
4700	9.409	80.369	71.852	40.030	-109.559	-80.923	1.717
4800	9.419	80.568	72.032	40.971	-110.081	-83.372	1.610
4900	9.429	80.762	72.208	41.914	-110.612	-85.807	1.508
5000	9.439	80.953	72.382	42.857	-111.156	-88.240	1.409
5100	9.448	81.140	72.552	43.801	-111.712	-90.656	1.314
5200	9.458	81.324	72.719	44.747	-112.278	-93.063	1.221
5300	9.467	81.505	72.884	45.693	-112.857	-95.458	1.132
5400	9.476	81.682	73.045	46.640	-113.450	-97.842	1.046
5500	9.485	81.857	73.204	47.588	-114.057	-100.210	0.962
5600	9.493	82.028	73.361	48.537	-114.679	-102.540	0.881
5700	9.502	82.197	73.515	49.487	-115.318	-104.920	0.802
5800	9.510	82.362	73.666	50.438	-115.977	-107.262	0.726
5900	9.518	82.526	73.816	51.389	-116.659	-109.592	0.652
6000	9.526	82.686	73.963	52.341	-117.365	-111.908	0.579

15 June 1963

HLS

TITANIUM MONOXIDE (TiO) (IDEAL MOLECULAR GAS) gfw = 63.90

$$\Delta H_{f0}^{\circ} = 12.896 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 13.0 \text{ kcal gfw}^{-1}$$

$$\text{Ground-State Configuration} = {}^3\Pi$$

$$S_{298.15}^{\circ} = 55.989 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.291 \text{ kcal gfw}^{-1}$$

State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
		cm ⁻¹	cm ⁻¹	cm ⁻¹	cm ⁻¹	cm ⁻¹	cm ⁻¹	cm ⁻¹	cm ⁻¹
$X^3\Pi$	2	0	1008.6	4.61	0	0.5355	0.0031	0	0.603
	2	66.7	1008.6	4.61	0	0.5355	0.0031	0	0.603
	2	141.3	1008.6	4.61	0	0.5355	0.0031	0	0.603
$a^1\Delta$	2	581	1009.6	0.0	0	0.5362	0.0	0	0.604
$d^1\Sigma$	1	1708	1023.8	4.64	0	0.5490	0.00337	0	0.0
$b^1\Pi$	2	10814	918.7	3.75	0	0.513	0.0029	0	0.0

Heat of Formation

Has been based on a preliminary analysis; a value of $\Delta H_{298.15}^{\circ} = 13.0 \text{ kcal gfw}^{-1}$ is accepted. See volume 1, this study (section IVB30.4.1) for further references.

Heat Capacity and Entropy

Have been calculated by use of diatomic gas program. Energy levels are based on Herzberg,¹ Phillips,² and Pettersson and Lindgren.³

References

1. Herzberg, G., Spectra of Diatomic Molecules, Van Nostrand, New York (1950).
2. Phillips, J. G., Astrophys. J. **115**, 567 (1952).
3. Pettersson, A. V. and B. Lindgren, Arkiv Fysik **22**, 491 (1962).

TITANIUM MONOXIDE (TiO) (IDEAL MOLECULAR GAS) GFW = 63.90

SUMMARY OF UNCERTAINTY ESTIMATES

T °K	C_p°	S_T°	$-(E_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔI_f°	Log K_p
298.15	± 0.300	± 1.500	± 1.500	± 0.000	± 5.000		
1000	± 0.300	± 1.500	± 1.500	± 0.200			
2000	± 0.200	± 2.000	± 2.000	± 0.300			
3000	± 0.200	± 2.000	± 2.000	± 0.400			
4000	± 0.200	± 2.000	± 2.000	± 0.600			
5000	± 0.200	± 2.000	± 2.000	± 0.800			
6000	± 0.200	± 2.000	± 2.000	± 1.000			

URANIUM MONOXIDE

TABLE 193
IDEAL MOLECULAR GAS

OU

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid U from 0° to 1406°K,
Liquid U from 1406° to 4124°K, Gaseous U from 4124° to 6000°K;
Gaseous O₂; Gaseous UO.

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p	%	-(F ₂ - H ₂₉₈)/T	H ₂ - H ₂₉₈	ΔH_f°	ΔF_f°	
0	0.000	0.000	INFINITE	-2.105	-11.346	-11.346	INFINITE
298.15	7.429	57.657	57.657	0.000	-11.800	-18.108	13.273
300	7.436	57.703	57.657	0.014	-11.804	-18.148	13.220
400	7.812	59.896	57.954	0.777	-12.081	-20.221	11.048
500	8.098	61.671	58.525	1.573	-12.382	-22.221	9.712
600	8.300	63.167	59.178	2.394	-12.726	-24.158	8.799
700	8.443	64.458	59.842	3.231	-13.134	-26.032	8.127
800	8.545	65.592	60.491	4.081	-13.629	-27.841	7.605
900	8.620	66.603	61.115	4.939	-14.229	-29.583	7.183
940	8.644	66.979	61.357	5.285	-14.503	-30.260	7.035
940	8.644	66.979	61.357	5.285	-15.188	-30.260	7.035
1000	8.676	67.514	61.710	5.804	-15.527	-31.210	6.821
1048	8.698	67.922	61.985	6.221	-15.798	-31.957	6.664
1048	8.698	67.922	61.985	6.221	-16.918	-31.957	6.664
1100	8.719	68.344	62.276	6.674	-17.160	-32.647	6.496
1200	8.753	69.104	62.814	7.548	-17.625	-34.089	6.208
1300	8.780	69.805	63.325	8.424	-18.092	-35.442	5.958
1400	8.801	70.457	63.811	9.304	-18.559	-36.759	5.738
1406	8.802	70.494	63.840	9.356	-18.588	-36.839	5.726
1406	8.802	70.494	63.840	9.356	-23.288	-36.839	5.726
1500	8.819	71.065	64.275	10.185	-23.728	-37.730	5.497
1600	8.835	71.634	64.717	11.067	-24.200	-38.647	5.279
1700	8.845	72.170	65.140	11.951	-24.672	-39.535	5.082
1800	8.855	72.676	65.545	12.836	-25.147	-40.397	4.905
1900	8.864	73.155	65.933	13.722	-25.623	-41.232	4.743
2000	8.872	73.610	66.305	14.609	-26.101	-42.038	4.593
2100	8.878	74.043	66.664	15.496	-26.582	-42.826	4.457
2200	8.884	74.456	67.009	16.385	-27.063	-43.587	4.330
2300	8.889	74.851	67.341	17.273	-27.548	-44.328	4.212
2400	8.893	75.229	67.662	18.162	-28.035	-45.046	4.102
2500	8.897	75.593	67.972	19.052	-28.524	-45.746	3.999
2600	8.900	75.942	68.272	19.942	-29.015	-46.425	3.902
2700	8.903	76.278	68.562	20.832	-29.510	-47.085	3.811
2800	8.906	76.601	68.843	21.722	-30.005	-47.724	3.725
2900	8.909	76.914	69.116	22.613	-30.503	-48.350	3.644
3000	8.911	77.216	69.381	23.504	-31.003	-48.956	3.566
3100	8.913	77.508	69.639	24.395	-31.506	-49.547	3.493
3200	8.915	77.791	69.889	25.287	-32.010	-50.122	3.423
3300	8.916	78.066	70.133	26.178	-32.516	-50.681	3.356
3400	8.918	78.332	70.370	27.070	-33.024	-51.221	3.292
3500	8.919	78.590	70.601	27.962	-33.533	-51.747	3.231
3600	8.920	78.842	70.827	28.854	-34.046	-52.262	3.173
3700	8.922	79.086	71.047	29.746	-34.560	-52.763	3.116
3800	8.923	79.324	71.261	30.638	-35.075	-53.245	3.062
3900	8.924	79.556	71.471	31.530	-35.593	-53.715	3.010
4000	8.925	79.782	71.676	32.423	-36.111	-54.174	2.960
4100	8.925	80.002	71.876	33.315	-36.632	-54.620	2.911
4123.63	8.926	80.053	71.923	33.526	-36.755	-54.723	2.900
4123.63	8.926	80.053	71.923	33.526	-143.656	-54.727	2.900
4200	8.926	80.217	72.072	34.208	-144.143	-55.069	2.761
4300	8.927	80.427	72.264	35.100	-144.687	-55.896	2.587
4400	8.928	80.632	72.452	35.993	-145.239	-56.703	2.419
4500	8.928	80.833	72.636	36.886	-145.796	-57.499	2.258
4600	8.929	81.029	72.817	37.779	-146.361	-58.281	2.104
4700	8.930	81.221	72.993	38.672	-146.931	-59.040	1.955
4800	8.930	81.409	73.167	39.565	-147.510	-59.791	1.812
4900	8.931	81.593	73.337	40.458	-148.094	-60.532	1.674
5000	8.931	81.774	73.504	41.351	-148.687	-61.250	1.541
5100	8.932	81.951	73.668	42.244	-149.287	-61.960	1.412
5200	8.932	82.124	73.829	43.137	-149.894	-62.650	1.288
5300	8.932	82.294	73.987	44.030	-150.509	-63.333	1.168
5400	8.933	82.461	74.142	44.924	-151.134	-64.009	1.052
5500	8.933	82.625	74.295	45.817	-151.769	-64.650	0.940
5600	8.933	82.786	74.445	46.710	-152.416	-65.289	0.831
5700	8.934	82.944	74.593	47.604	-153.075	-65.914	0.725
5800	8.934	83.100	74.738	48.497	-153.752	-66.518	0.622
5900	8.934	83.252	74.881	49.390	-154.446	-67.114	0.523
6000	8.935	83.403	75.022	50.284	-155.150	-67.704	0.426

15 June 1963

MBP

URANIUM MONOXIDE (UO) (IDEAL MOLECULAR GAS) gfw = 254.07

$$\Delta H_{f0} = -11.346 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -11.8 \pm 10 \text{ kcal gfw}^{-1}$$

Ground State Configuration $^1\Sigma$

$$S_{298.15}^{\circ} = 57.7 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.105 \text{ kcal gfw}^{-1}$$

Spectroscopic Constants
cm ⁻¹
$\omega_e = 920$
$B_e = 0.2924$

Heat of Formation

Calculated from the data of DeMaria, Burns, Drowart, and Inghram.¹

Heat Capacity and Entropy

Calculated using the diatomic gas program and the constants listed above.

Reference

1. DeMaria, G., P. Burns, J. Drowart, and M. Inghram, J. Chem. Phys. 32, 1373 (1960).

TABLE 194

TUNGSTEN MONOXIDE

IDEAL MOLECULAR GAS

OW

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid W from 0° to 3650°K,
 Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K;
 Gaseous O₂; Gaseous WO.

T, °K	C_p°	$\frac{cal}{^\circ K \text{ g-atom}}$ S_T°	$-(H_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	Kcal/g-atom ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.122	97.510	97.510	INFINITE
298.15	7.601	56.597	56.597	0.000	97.400	90.166	-66.090
300	7.609	56.643	56.597	0.014	97.396	90.121	-65.650
400	7.990	58.888	56.900	0.795	97.234	87.730	-47.931
500	8.252	60.701	57.485	1.608	97.081	85.362	-37.310
600	8.428	62.222	58.151	2.443	96.931	83.044	-30.247
700	8.547	63.531	58.828	3.292	96.777	80.728	-25.203
800	8.631	64.678	59.485	4.151	96.616	78.461	-21.433
900	8.691	65.698	60.123	5.017	96.446	76.184	-18.499
1000	8.736	66.616	60.728	5.889	96.273	73.962	-16.164
1100	8.770	67.450	61.301	6.764	96.088	71.717	-14.248
1200	8.796	68.215	61.846	7.642	95.896	69.535	-12.663
1300	8.817	68.920	62.363	8.523	95.689	67.319	-11.317
1400	8.834	69.574	62.855	9.405	95.466	65.145	-10.169
1500	8.847	70.183	63.324	10.290	95.230	62.988	-9.177
1600	8.859	70.755	63.771	11.175	94.974	60.843	-8.310
1700	8.868	71.292	64.197	12.061	94.701	58.721	-7.549
1800	8.876	71.799	64.606	12.948	94.410	56.614	-6.873
1900	8.883	72.279	64.997	13.836	94.104	54.521	-6.271
2000	8.888	72.735	65.373	14.725	93.780	52.444	-5.731
2100	8.893	73.169	65.734	15.614	93.439	50.387	-5.244
2200	8.897	73.583	66.081	16.503	93.080	48.345	-4.802
2300	8.901	73.978	66.416	17.393	92.705	46.320	-4.401
2400	8.905	74.357	66.739	18.284	92.311	44.314	-4.035
2500	8.908	74.721	67.051	19.174	91.900	42.323	-3.700
2600	8.910	75.070	67.353	20.065	91.472	40.347	-3.391
2700	8.911	75.407	67.645	20.956	91.028	38.386	-3.107
2800	8.915	75.731	67.928	21.848	90.565	36.445	-2.845
2900	8.917	76.044	68.202	22.739	90.085	34.525	-2.602
3000	8.918	76.346	68.469	23.631	89.588	32.613	-2.376
3100	8.920	76.638	68.728	24.523	89.075	30.724	-2.166
3200	8.921	76.922	68.979	25.415	88.543	28.854	-1.971
3300	8.922	77.196	69.224	26.307	87.995	26.994	-1.788
3400	8.924	77.463	69.463	27.200	87.431	25.153	-1.617
3500	8.925	77.721	69.695	28.092	86.848	23.328	-1.457
3600	8.926	77.973	69.921	28.985	86.249	21.528	-1.307
3700	8.927	78.217	70.142	29.877	85.634	19.754	-1.166
3800	8.927	78.455	70.358	30.770	85.004	18.004	-1.033
3900	8.928	78.687	70.569	31.663	84.359	16.274	-0.904
4000	8.929	78.913	70.774	32.555	83.699	14.564	-0.783
4100	8.930	79.134	70.976	33.448	83.024	12.874	-0.663
4200	8.930	79.349	71.172	34.341	82.334	11.204	-0.550
4300	8.931	79.559	71.365	35.234	81.629	9.554	-0.445
4400	8.931	79.764	71.554	36.128	80.909	7.929	-0.345
4500	8.932	79.965	71.738	37.021	80.174	6.324	-0.250
4600	8.932	80.161	71.919	37.914	79.424	4.744	-0.160
4700	8.933	80.353	72.097	38.807	78.659	3.184	-0.074
4800	8.933	80.542	72.271	39.700	77.879	1.644	-0.001
4900	8.933	80.726	72.441	40.594	77.084	0.124	0.074
5000	8.934	80.906	72.609	41.487	76.274	-0.384	0.154
5100	8.934	81.081	72.773	42.381	75.449	-0.894	0.234
5200	8.935	81.257	72.935	43.274	74.609	-1.404	0.314
5300	8.935	81.427	73.093	44.167	73.754	-1.914	0.394
5400	8.935	81.594	73.249	45.061	72.884	-2.424	0.474
5500	8.935	81.758	73.402	45.954	71.999	-2.934	0.554
5600	8.936	81.919	73.553	46.848	71.099	-3.444	0.634
5700	8.936	82.077	73.701	47.742	70.184	-3.954	0.714
5800	8.936	82.232	73.847	48.635	69.254	-4.464	0.794
5891	8.936	82.371	73.977	49.529	68.309	-4.974	0.874
5891	8.936	82.371	73.977	49.529	68.309	-4.974	0.874
5900	8.936	82.385	73.990	49.529	68.309	-4.974	0.874
6000	8.937	82.515	74.137	50.422	67.354	-5.484	0.954

May 1962

CHW

TUNGSTEN MONOXIDE (WO) (IDEAL MOLECULAR GAS) gfw = 199.86

$$\Delta H_{f0}^{\circ} = 97.510 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 97.400 \text{ kcal gfw}^{-1}$$

Ground State Configuration = 1λ

$$S_{298.15}^{\circ} = 56.597 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.122 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	<i>K</i>	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	a_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
1λ	1	0.0	803	-	-	0.36149	-	-	-

Heat of Formation

Based on work of DeMaria and co-workers.¹

Heat Capacity and Entropy

Calculated using estimated constants.²

References

1. De Maria, G. et al, J. Chem. Phys. 32, 1373 (1960).
2. Barriault, R. J. et al, ASD TR 61-260, (May 1962), Pt. 1.

TABLE 195

YTTRIUM MONOXIDE

IDEAL MOLECULAR GAS

OY

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Y from 0° to 1803°K.
 Liquid Y from 1803° to 3605°K, Gaseous Y from 3605° to 6000°K; Gaseous O₂; Gaseous YO.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.115	-11.800	-11.800	INFINITE
298.15	7.537	55.883	55.883	0.000	-12.148	-18.334	13.439
300	7.545	55.930	55.883	0.014	-12.152	-18.373	13.384
400	7.932	58.156	56.184	0.789	-12.375	-20.412	11.152
500	8.210	59.958	56.764	1.597	-12.592	-22.396	9.789
600	8.401	61.473	57.426	2.428	-12.814	-24.337	8.864
700	8.535	62.778	58.100	3.275	-13.046	-26.239	8.192
800	8.630	63.925	58.758	4.134	-13.294	-28.108	7.678
900	8.701	64.945	59.389	5.000	-13.561	-29.942	7.271
1000	8.755	65.865	59.992	5.873	-13.845	-31.747	6.938
1100	8.797	66.701	60.564	6.751	-14.147	-33.523	6.660
1200	8.830	67.468	61.108	7.632	-14.469	-35.270	6.423
1300	8.858	68.176	61.625	8.517	-14.808	-36.990	6.218
1400	8.881	68.834	62.117	9.404	-15.169	-38.685	6.039
1500	8.900	69.447	62.585	10.293	-15.549	-40.350	5.879
1600	8.918	70.022	63.032	11.184	-15.951	-41.990	5.735
1700	8.933	70.563	63.459	12.076	-16.373	-43.605	5.606
1758	8.940	70.859	63.696	12.594	-16.679	-44.527	5.535
1758	8.940	70.859	63.696	12.594	-17.318	-44.527	5.535
1800	8.946	71.074	63.868	12.970	-17.981	-45.166	5.484
1803	8.946	71.088	63.880	12.997	-17.992	-45.211	5.480
1803	8.946	71.088	63.880	12.997	-20.724	-45.211	5.480
1900	8.954	71.558	64.261	13.865	-21.289	-46.516	5.350
2000	8.972	72.018	64.637	14.762	-21.872	-47.826	5.226
2100	8.984	72.456	64.999	15.660	-22.458	-49.109	5.111
2200	8.997	72.874	65.348	16.559	-23.044	-50.365	5.003
2300	9.010	73.275	65.684	17.459	-23.632	-51.594	4.902
2400	9.025	73.659	66.008	18.361	-24.222	-52.798	4.808
2500	9.041	74.027	66.322	19.264	-24.813	-53.977	4.718
2600	9.059	74.382	66.625	20.169	-25.404	-55.130	4.634
2700	9.078	74.725	66.919	21.076	-25.997	-56.265	4.554
2800	9.090	75.044	67.203	21.985	-26.589	-57.374	4.478
2900	9.104	75.375	67.480	22.896	-27.182	-58.462	4.406
3000	9.119	75.685	67.748	23.810	-27.774	-59.531	4.337
3100	9.131	75.986	68.009	24.727	-28.367	-60.578	4.271
3200	9.143	76.278	68.264	25.646	-28.959	-61.609	4.207
3300	9.154	76.562	68.510	26.569	-29.548	-62.621	4.147
3400	9.167	76.839	68.751	27.496	-30.137	-63.615	4.089
3500	9.179	77.108	68.986	28.427	-30.725	-64.590	4.033
3600	9.192	77.372	69.216	29.362	-31.307	-65.552	3.979
3604.66	9.194	77.384	69.226	29.406	-31.334	-65.596	3.977
3604.66	9.194	77.384	69.226	29.406	-118.312	-65.596	3.977
3700	9.204	77.629	69.440	30.301	-118.358	-66.207	3.792
3800	9.217	77.861	69.659	31.246	-118.741	-66.739	3.608
3900	9.231	78.128	69.873	32.195	-119.147	-67.259	3.433
4000	9.243	78.370	70.083	33.150	-119.571	-67.774	3.266
4100	9.259	78.607	70.288	34.110	-120.014	-68.273	3.106
4200	9.277	78.840	70.489	35.076	-120.476	-68.760	2.953
4300	9.297	79.065	70.686	36.047	-120.954	-69.234	2.807
4400	9.309	79.294	70.879	37.025	-121.448	-69.702	2.667
4500	9.322	79.516	71.069	38.010	-121.955	-70.162	2.533
4600	9.336	79.734	71.255	39.000	-122.477	-70.619	2.404
4700	10.007	79.948	71.438	39.997	-123.010	-71.074	2.280
4800	10.068	80.160	71.618	41.001	-123.555	-71.529	2.161
4900	10.135	80.369	71.795	42.012	-124.108	-71.987	2.046
5000	10.203	80.574	71.968	43.029	-124.672	-72.438	1.934
5100	10.271	80.777	72.140	44.053	-125.244	-72.886	1.828
5200	10.339	80.978	72.308	45.085	-125.823	-73.333	1.724
5300	10.407	81.176	72.474	46.123	-126.410	-73.779	1.624
5400	10.475	81.372	72.637	47.168	-127.005	-74.224	1.528
5500	10.543	81.564	72.798	48.219	-127.609	-74.667	1.434
5600	10.610	81.756	72.957	49.278	-128.220	-75.110	1.343
5700	10.677	81.945	73.113	50.344	-128.836	-75.552	1.255
5800	10.743	82.132	73.267	51.416	-129.457	-76.001	1.170
5900	10.808	82.317	73.420	52.495	-130.082	-76.446	1.087
6000	10.872	82.500	73.570	53.581	-130.715	-76.888	1.006

15 March 1963

MG

$$\Delta H_{f0}^{\circ} = -11.8 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $^2\Sigma$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.115 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -12.148 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 55.883 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^7$
$^2\Sigma$	2	0.0	852.5	2.45	0.0273	0.3889	0.0016	0.0	3.2
A $^2\Pi$	2	16294.72	812.7	2.80	0.0	0.3867	0.0019	0.0	3.5
A $^2\Pi$	2	16722.75	808.9	2.96	0.0	0.3867	0.0019	0.0	3.5
B $^2\Sigma$	2	20741.92	765.03	7.75	0.0	0.3742	0.0039	0.0	3.9

Heat of Formation

From a study of vaporization of Y_2O_3 by Walsh et al.¹

Heat Capacity and Entropy

Calculated on diatomic gas program.

Reference

1. Walsh, P. N., H. W. Goldstein and D. White, J. Am. Ceram. Soc. 43, 229 (1960).

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Zr from 0° to 2125°K,
Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K;
Gaseous O₂, Gaseous ZrO.

T, °K	C _p	cal/°K gfw - S _T	-(F _T - H ₂₉₈)/T	H _T - H ₂₉₈	Kcal/gfw ΔH _f	ΔF _f	Log K _p
0	0.000	0.000	INFINITE	-2.335	21.116	21.116	INFINITE
298.15	8.632	57.055	57.055	0.000	21.100	14.165	-10.382
300	8.636	57.108	57.055	0.016	21.098	14.122	-10.287
400	8.829	59.621	57.396	0.890	20.986	11.812	-6.453
500	8.948	61.605	58.047	1.779	20.837	9.535	-4.167
600	9.018	63.243	58.780	2.678	20.657	7.291	-2.656
700	9.058	64.637	59.520	3.582	20.449	5.079	-1.586
800	9.079	65.848	60.237	4.489	20.215	2.899	-0.792
900	9.090	66.918	60.921	5.397	19.957	0.750	-0.182
1000	9.096	67.876	61.569	6.307	19.677	-1.368	0.299
1100	9.098	68.743	62.183	7.216	19.375	-3.460	0.687
1135	9.099	69.028	62.389	7.535	19.266	-4.184	0.806
1135	9.099	69.028	62.389	7.535	18.951	-4.184	0.806
1200	9.099	69.535	62.763	8.126	18.152	-5.470	0.996
1300	9.100	70.263	63.312	9.036	17.843	-7.425	1.248
1400	9.101	70.937	63.833	9.946	17.431	-9.358	1.461
1500	9.102	71.565	64.328	10.856	17.016	-11.268	1.642
1600	9.105	72.153	64.799	11.767	16.600	-13.157	1.797
1700	9.108	72.705	65.248	12.677	16.177	-15.025	1.932
1800	9.112	73.226	65.677	13.588	15.754	-16.875	2.049
1900	9.118	73.719	66.087	14.500	15.329	-18.706	2.152
2000	9.124	74.186	66.480	15.412	15.001	-20.520	2.242
2100	9.130	74.632	66.858	16.325	15.271	-22.319	2.323
2125	9.132	74.740	66.950	16.553	15.189	-22.764	2.341
2125	9.132	74.740	66.950	16.553	10.288	-22.764	2.341
2200	9.138	75.057	67.221	17.238	10.031	-23.926	2.377
2300	9.146	75.463	67.571	18.152	9.688	-25.465	2.420
2400	9.155	75.853	67.908	19.067	9.342	-26.985	2.457
2500	9.164	76.227	68.233	19.983	8.993	-28.491	2.491
2600	9.173	76.586	68.548	20.900	8.644	-29.983	2.520
2700	9.183	76.933	68.852	21.818	8.293	-31.465	2.547
2800	9.192	77.267	69.147	22.737	7.942	-32.932	2.570
2900	9.202	77.590	69.432	23.656	7.586	-34.381	2.591
3000	9.212	77.902	69.710	24.577	7.231	-35.826	2.610
3100	9.222	78.204	69.979	25.499	6.875	-37.253	2.626
3200	9.232	78.497	70.241	26.421	6.516	-38.674	2.641
3300	9.242	78.782	70.495	27.345	6.157	-40.079	2.654
3400	9.251	79.058	70.743	28.270	5.798	-41.475	2.666
3500	9.261	79.326	70.985	29.195	5.435	-42.861	2.676
3600	9.270	79.588	71.220	30.122	5.073	-44.235	2.685
3700	9.280	79.842	71.450	31.049	4.710	-45.600	2.693
3800	9.289	80.090	71.674	31.978	4.347	-46.956	2.700
3900	9.298	80.331	71.893	32.907	3.981	-48.299	2.706
4000	9.307	80.567	72.108	33.837	3.615	-49.638	2.712
4100	9.315	80.797	72.317	34.768	3.248	-50.966	2.717
4200	9.324	81.022	72.522	35.700	2.880	-52.287	2.721
4300	9.332	81.242	72.722	36.633	2.512	-53.591	2.724
4400	9.340	81.456	72.919	37.567	2.142	-54.887	2.727
4500	9.348	81.667	73.111	38.501	1.770	-56.187	2.729
4600	9.356	81.873	73.299	39.436	1.397	-57.468	2.730
4644.05	9.360	81.962	73.381	39.849	1.234	-58.030	2.731
4644.05	9.360	81.962	73.381	849	-134.220	-58.030	2.731
4700	9.364	82.074	73.484	40.372	-134.485	-57.113	2.656
4800	9.371	82.272	73.666	41.309	-134.963	-55.467	2.525
4900	9.379	82.465	73.844	42.247	-135.448	-53.804	2.400
5000	9.386	82.655	74.018	43.185	-135.942	-52.130	2.278
5100	9.393	82.842	74.190	44.124	-136.444	-50.458	2.162
5200	9.401	83.024	74.358	45.064	-136.955	-48.762	2.049
5300	9.408	83.204	74.524	46.004	-137.476	-47.066	1.941
5400	9.414	83.380	74.687	46.945	-138.007	-45.358	1.836
5500	9.421	83.554	74.847	47.887	-138.549	-43.638	1.734
5600	9.428	83.724	75.004	48.829	-139.105	-41.903	1.635
5700	9.435	83.891	75.159	49.772	-139.676	-40.164	1.540
5800	9.441	84.056	75.312	50.716	-140.264	-38.417	1.448
5900	9.448	84.218	75.462	51.661	-140.871	-36.655	1.358
6000	9.454	84.377	75.610	52.606	-141.502	-34.880	1.270

ZIRCONIUM MONOXIDE (ZrO) (IDEAL MOLECULAR GAS) gfw = 107.22

$$\Delta H_{f0}^{\circ} = 21.116 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 21.1 \text{ kcal gfw}^{-1}$$

Ground-State Configuration = 3Δ

$$S_{298.15}^{\circ} = 57.055 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.335 \text{ kcal gfw}^{-1}$$

State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	α_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
$c^1\Sigma$	1	cm ⁻¹ 9171.2	cm ⁻¹ 938.1	cm ⁻¹ 1.80	cm ⁻¹ ---	cm ⁻¹ 0.3951	cm ⁻¹ 0.0019	cm ⁻¹ ---	cm ⁻¹ 0.35
$a^1\Sigma$	1	1320.3	978.07	5.04	---	0.4241	0.0023	---	0.33
$x^3\Delta$	2	605.1	936.5	3.47	---	0.4156	0.0021	---	0.32
	2	297.2							
	2	0							

Heat of Formation

No analysis has been performed; data of JANAF Tables¹ have been accepted temporarily.

Heat Capacity and Entropy

Have been calculated; have used above energy levels. See volume 1, this study (section IVB35.4.1) for details.

Reference

1. JANAF, Thermochemical Tables (30 September 1961).

ZIRCONIUM MONOXIDE (ZrO) (IDEAL MOLECULAR GAS)

GFW = 107.22

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	c_p	Δc_p	ΔH_f°	$-(H_f^{\circ} - H_{298}^{\circ})/T$	$H_f^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	± 0.200	± 1.000	± 1.000	± 0.000	± 0.000	± 5.000		
1000	± 0.500	± 1.700	± 1.200	± 0.500				
2000	± 0.500	± 2.000	± 1.600	± 1.000				
3000	± 0.500	± 2.200	± 1.800	± 1.300				
4000	± 0.500	± 2.300	± 1.900	± 1.600				
5000	± 0.500	± 2.400	± 2.000	± 1.900				
6000	± 0.500	± 2.400	± 2.000	± 2.000				

TABLE 197

OXYGEN

REFERENCE STATE

O₂

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$:
Gaseous Diatomic O₂ from O* to 6000°K.

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.075			
298.15	7.021	49.007	49.007	0.000			
300	7.024	49.051	49.007	0.013			
400	7.196	51.092	49.284	0.723			
500	7.431	52.723	49.814	1.454			
600	7.670	54.099	50.417	2.210			
700	7.884	55.298	51.030	2.987			
800	8.064	56.363	51.631	3.785			
900	8.213	57.321	52.211	4.599			
1000	8.336	58.193	52.767	5.427			
1100	8.439	58.993	53.297	6.266			
1200	8.527	59.731	53.803	7.114			
1300	8.604	60.417	54.285	7.971			
1400	8.674	61.057	54.746	8.835			
1500	8.738	61.657	55.187	9.705			
1600	8.799	62.223	55.609	10.582			
1700	8.858	62.759	56.014	11.465			
1800	8.915	63.267	56.403	12.354			
1900	8.972	63.750	56.777	13.248			
2000	9.028	64.212	57.138	14.148			
2100	9.083	64.654	57.485	15.054			
2200	9.138	65.077	57.821	15.965			
2300	9.193	65.485	58.145	16.881			
2400	9.246	65.877	58.459	17.803			
2500	9.299	66.256	58.763	18.731			
2600	9.351	66.622	59.059	19.663			
2700	9.402	66.975	59.345	20.601			
2800	9.451	67.318	59.624	21.543			
2900	9.499	67.651	59.895	22.491			
3000	9.546	67.974	60.159	23.443			
3100	9.591	68.288	60.417	24.400			
3200	9.635	68.593	60.667	25.362			
3300	9.677	68.890	60.912	26.327			
3400	9.718	69.180	61.151	27.297			
3500	9.758	69.462	61.385	28.271			
3600	9.796	69.738	61.613	29.249			
3700	9.833	70.007	61.836	30.230			
3800	9.869	70.269	62.055	31.215			
3900	9.905	70.526	62.269	32.204			
4000	9.940	70.778	62.479	33.196			
4100	9.976	71.024	62.684	34.192			
4200	10.012	71.265	62.886	35.192			
4300	10.049	71.501	63.084	36.195			
4400	10.088	71.733	63.278	37.203			
4500	10.130	71.960	63.468	38.214			
4600	10.176	72.184	63.656	39.230			
4700	10.226	72.404	63.840	40.251			
4800	10.283	72.620	64.021	41.278			
4900	10.347	72.834	64.199	42.311			
5000	10.421	73.044	64.374	43.352			
5100	10.506	73.252	64.546	44.402			
5200	10.607	73.459	64.716	45.462			
5300	10.724	73.663	64.883	46.535			
5400	10.863	73.867	65.048	47.623			
5500	11.027	74.070	65.211	48.728			
5600	11.222	74.274	65.371	49.855			
5700	11.453	74.479	65.530	51.007			
5800	11.727	74.685	65.687	52.191			
5900	12.052	74.895	65.842	53.412			
6000	12.439	75.109	65.996	54.677			

May 1962

RCF

OXYGEN (O₂)

(REFERENCE STATE)

gfw = 32.000

$$\Delta H_{f0}^{\circ} = 0.0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0.0 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^3\Sigma_g^-$$

$$S_{298.15}^{\circ} = 49.007 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.075 \text{ kcal gfw}^{-1}$$

cm ⁻¹									
State	g	E	ω_e	$\omega_e x_e$	$\omega_e y_e$	B_e	a_e	$\gamma_e \times 10^5$	$D_e \times 10^6$
X ${}^3\Sigma_g^-$	3	-0.244	1580.1622	12.07	.0546	1.44531	0.01579	-	4.96
a ${}^1\Delta_g$	2	7882.36	1509.1	12.9	-	1.426	0.0171	-	5.1
b ${}^1\Sigma_g^+$	1	13120.917	1432.507	13.9466	-.01075	1.40007	0.01817	-4.3	5.36
A ${}^3\Sigma_u^+$	3	35008.0	801.	15.0	-	0.91	0.015	-	3.4
${}^1\Sigma_u^-$	7	36212.8	650.41	17.03	-0.106	0.826	0.0205	-83.0	5.3
B ${}^3\Sigma_u^-$	3	49357.6	709.4	8.0	-0.375	0.819	0.011	-	4.4

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Calculated on diatomic gas-computer program, using above spectroscopic constants. Complete details of data used given by Barriault et al¹.

Reference

1. Barriault, R. J. et al, ASD TR 61-260 (May 1962), Pt. 1.

OXYGEN (O₂)

(REFERENCE STATE)

GFW = 32.000

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	± 0.000	± 0.003	± 0.003	± 0.000			
1000	± 0.001	± 0.004	± 0.004	± 0.001			
2000	± 0.002	± 0.005	± 0.004	± 0.002			
3000	± 0.005	± 0.007	± 0.004	± 0.005			
4000	± 0.014	± 0.009	± 0.006	± 0.014			
5000	± 0.089	± 0.018	± 0.007	± 0.057			
6000	± 0.673	± 0.081	± 0.013	± 0.407			

TABLE 198

OSMIUM DIOXIDE

IDEAL MOLECULAR GAS

O₂O₅

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Os from 0° to 3290°K, Liquid Os from 3290° to 5270°K, Gaseous Os from 5270° to 6000°K; Gaseous O₂; Gaseous OsO₂.

T, °K	C_p	$\frac{\text{cal}}{^\circ\text{K gfw}}$ ΔT	$-\frac{(F_T^\circ - H_{298}^\circ)/T}{T}$	$\frac{\text{Kcal}}{\text{gfw}}$ ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.849	17.836	17.836
298.15	11.914	61.455	61.455	0.000	17.400	16.014
300	11.934	61.524	61.456	0.022	17.398	16.005
400	12.835	65.045	61.936	1.264	17.330	15.553
500	13.422	68.026	62.869	2.579	17.306	15.113
600	13.805	70.510	63.941	3.941	17.294	14.675
700	14.063	72.659	65.036	5.336	17.286	14.240
800	14.242	74.549	66.110	6.751	17.268	13.805
900	14.371	76.234	67.143	8.182	17.241	13.373
1000	14.467	77.754	68.129	9.624	17.203	12.947
1100	14.539	79.136	69.068	11.075	17.153	12.524
1200	14.595	80.403	69.961	12.532	17.092	12.104
1300	14.639	81.573	70.809	13.993	17.017	11.692
1400	14.674	82.660	71.617	15.459	16.931	11.286
1500	14.703	83.673	72.388	16.928	16.834	10.885
1600	14.727	84.621	73.123	18.400	16.723	10.491
1700	14.747	85.516	73.826	19.873	16.599	10.107
1800	14.764	86.360	74.499	21.349	16.463	9.728
1900	14.778	87.158	75.145	22.826	16.314	9.357
2000	14.790	87.917	75.764	24.304	16.152	8.998
2100	14.800	88.638	76.360	25.784	15.976	8.645
2200	14.810	89.327	76.934	27.264	15.787	8.301
2300	14.818	89.986	77.487	28.746	15.586	7.963
2400	14.825	90.616	78.021	30.228	15.370	7.637
2500	14.831	91.222	78.537	31.711	15.141	7.318
2600	14.836	91.804	79.037	33.194	14.898	7.010
2700	14.841	92.364	79.520	34.678	14.642	6.711
2800	14.846	92.903	79.988	36.162	14.373	6.424
2900	14.850	93.424	80.443	37.647	14.090	6.142
3000	14.853	93.928	80.884	39.132	13.795	5.874
3100	14.856	94.415	81.312	40.618	13.486	5.620
3200	14.859	94.887	81.729	42.103	13.163	5.368
3290	14.862	95.248	82.094	43.440	12.862	5.155
3290	14.862	95.298	82.094	43.440	5.295	5.155
3300	14.862	95.344	82.135	43.589	5.258	5.154
3400	14.864	95.788	82.530	45.076	4.375	5.157
3500	14.867	96.219	82.915	46.562	4.477	5.171
3600	14.869	96.637	83.290	48.049	4.074	5.196
3700	14.871	97.045	83.657	49.536	3.702	5.231
3800	14.872	97.441	84.014	51.023	3.304	5.282
3900	14.874	97.828	84.363	52.511	2.903	5.337
4000	14.875	98.204	84.705	53.998	2.498	5.404
4100	14.877	98.572	85.039	55.486	2.090	5.481
4200	14.878	98.930	85.365	56.973	1.677	5.573
4300	14.879	99.280	85.685	58.461	1.262	5.670
4400	14.881	99.622	85.998	59.949	0.842	5.775
4500	14.882	99.957	86.304	61.437	0.419	5.893
4600	14.883	100.284	86.604	62.926	-0.008	6.029
4700	14.883	100.604	86.899	64.414	-0.441	6.162
4800	14.884	100.917	87.188	65.902	-0.880	6.307
4900	14.885	101.224	87.471	67.391	-1.324	6.463
5000	14.886	101.525	87.749	68.879	-1.777	6.630
5100	14.887	101.820	88.027	70.368	-2.238	6.802
5200	14.887	102.109	88.290	71.857	-2.709	6.990
5269.57	14.888	102.307	88.475	72.899	-3.044	7.113
5269.57	14.888	102.307	88.475	72.899	-179.445	7.113
5300	14.888	102.392	88.554	73.345	-179.588	8.199
5400	14.889	102.671	88.813	74.834	-180.066	11.752
5500	14.889	102.944	89.067	76.323	-180.565	15.151
5600	14.890	103.212	89.317	77.812	-181.088	18.878
5700	14.890	103.476	89.563	79.301	-181.639	22.462
5800	14.891	103.735	89.805	80.790	-182.225	26.054
5900	14.891	103.989	90.044	82.279	-182.850	29.654
6000	14.892	104.240	90.278	83.768	-183.521	33.270

15 September 1962

CHW

OSMIUM DIOXIDE (OsO₂)

(IDEAL MOLECULAR GAS)

gfw = 222.2

$$\Delta H_{f0}^{\circ} = 17.836 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 17.400 \text{ kcal gfw}^{-1}$$

Point Group = D_{∞v}

$$S_{298.15}^{\circ} = 61.455 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.849 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
764 (1)	825 (1)
215 (2)	

Bond lengths and angles:

Os-O distance = 185 Å

 $\sigma = 2$

O-Os-O angle = 180°

Heat of FormationEstimated from Brewer et al data.¹Heat Capacity and Entropy

Determined from the estimated spectroscopic data. See volume 1, this study (section IVB18.4.2) for details.

Reference

1. Brewer, L. and G. M. Rosenblatt, Chem. Revs. 61, 257 (1961).²

Reference State for Calculating ΔH_f° , ΔF_f° and $\log K_p$: Solid Si from 0° to 1690°K, Liquid Si from 1690° to 3566°K, Gaseous Si from 3566° to 6000°K, Gaseous O₂: α -Quartz from 0° to 848°K, β -Quartz from 848° to 1298°K, α -Cristobalite from 1298° to 1996°K, Liquid SiO₂ from 1996° to 6000°K.

T, °K	ΔH_f° cal/K gfw	ΔH_f° Kcal/gfw	ΔF_f° cal/K gfw	ΔF_f° Kcal/gfw	ΔF_f° Kcal/gfw	ΔF_f° Kcal/gfw	Log K _p
0	0.000	0.000	INFINITE	-1.664	-216.820	-216.820	INFINITE
298.15	10.627	10.000	10.000	0.000	-218.000	-205.019	150.276
300	10.680	10.066	10.000	0.020	-218.002	-204.939	149.291
400	12.812	13.457	10.448	1.204	-218.036	-200.576	109.584
500	14.240	16.477	11.358	2.560	-217.960	-196.217	85.762
600	15.390	19.178	12.440	4.043	-217.807	-191.881	69.889
700	16.409	21.628	13.580	5.633	-217.585	-187.577	58.561
800	17.358	23.882	14.729	7.322	-217.299	-183.310	50.076
848	17.798	24.906	15.276	8.166	-217.139	-181.276	46.717
848	16.055	25.248	15.276	8.456	-216.849	-181.276	46.717
900	16.156	26.206	15.880	9.293	-216.759	-179.097	43.489
1000	16.350	27.919	17.000	10.919	-216.590	-174.920	38.227
1100	16.544	29.486	18.065	12.563	-216.424	-170.762	33.926
1200	16.738	30.934	19.078	14.228	-216.256	-166.618	30.344
1298	16.928	32.255	20.023	15.877	-216.092	-162.570	27.371
1298	17.048	32.394	20.023	16.057	-215.912	-162.570	27.371
1300	17.052	32.420	20.042	16.091	-215.908	-162.489	27.316
1400	17.256	33.691	20.972	17.807	-215.723	-158.387	24.724
1500	17.460	34.889	21.860	19.543	-215.534	-154.296	22.480
1600	17.664	36.022	22.710	21.299	-215.340	-150.221	20.518
1690	17.848	36.994	23.445	22.897	-215.160	-146.564	18.953
1690	17.848	36.994	23.445	22.897	-215.110	-146.564	18.953
1700	17.868	37.099	23.525	23.075	-215.090	-146.087	18.780
1800	18.072	38.126	24.308	24.872	-214.885	-141.327	17.159
1900	18.276	39.109	25.062	26.690	-214.672	-136.581	15.710
1996	18.472	40.014	25.759	28.454	-214.460	-132.032	14.456
1996	21.660	41.067	25.759	30.554	-214.360	-132.032	14.456
2000	21.660	41.110	25.790	30.640	-214.339	-131.848	14.407
2100	21.660	42.167	26.545	32.806	-214.127	-127.238	13.241
2200	21.660	43.174	27.278	34.972	-213.912	-122.652	12.184
2300	21.660	44.137	27.990	37.138	-213.700	-118.093	11.221
2400	21.660	45.059	28.682	39.304	-213.492	-113.554	10.340
2500	21.660	45.943	29.355	41.470	-213.288	-109.040	9.532
2600	21.660	46.793	30.010	43.636	-213.088	-104.544	8.787
2700	21.660	47.610	30.646	45.802	-212.892	-100.069	8.100
2800	21.660	48.398	31.266	47.968	-212.700	-95.612	7.462
2900	21.660	49.158	31.870	50.134	-212.512	-91.174	6.871
3000	21.660	49.892	32.459	52.300	-212.328	-86.753	6.320
3100	21.660	50.602	33.033	54.466	-212.148	-82.347	5.805
3200	21.660	51.290	33.593	56.632	-211.972	-77.962	5.324
3300	21.660	51.957	34.139	58.798	-211.800	-73.585	4.873
3400	21.660	52.603	34.673	60.964	-211.632	-69.226	4.450
3500	21.660	53.231	35.194	63.130	-211.468	-64.879	4.051
3565.77	21.660	53.634	35.530	64.555	-211.392	-62.026	3.801
3565.77	21.660	53.634	35.530	64.555	-211.392	-62.026	3.801
3600	21.660	53.841	35.704	65.296	-211.369	-59.672	3.622
3700	21.660	54.435	36.202	67.462	-211.205	-52.791	3.118
3800	21.660	55.012	36.689	69.628	-211.040	-45.925	2.641
3900	21.660	55.575	37.166	71.794	-210.880	-39.080	2.190
4000	21.660	56.123	37.633	73.960	-210.724	-32.244	1.762
4100	21.660	56.658	38.091	76.126	-210.572	-25.435	1.356
4200	21.660	57.180	38.539	78.292	-210.424	-18.626	0.969
4300	21.660	57.690	38.979	80.458	-210.280	-11.845	0.602
4400	21.660	58.188	39.410	82.624	-210.140	-5.071	0.252
4500	21.660	58.675	39.832	84.790	-210.004	1.690	-0.082
4600	21.660	59.151	40.247	86.956	-209.872	8.435	-0.401
4700	21.660	59.617	40.654	89.122	-209.744	15.167	-0.705
4800	21.660	60.073	41.054	91.288	-209.620	21.885	-0.996
4900	21.660	60.519	41.447	93.454	-209.500	28.592	-1.275
5000	21.660	60.957	41.833	95.620	-209.384	35.290	-1.542
5100	21.660	61.386	42.212	97.786	-209.272	41.978	-1.799
5200	21.660	61.806	42.585	99.952	-209.164	48.651	-2.045
5300	21.660	62.219	42.951	102.118	-209.060	55.316	-2.281
5400	21.660	62.624	43.312	104.284	-208.960	61.968	-2.508
5500	21.660	63.021	43.667	106.450	-208.864	68.616	-2.726
5600	21.660	63.411	44.016	108.616	-208.772	75.250	-2.937
5700	21.660	63.795	44.359	110.782	-208.684	81.877	-3.139
5800	21.660	64.172	44.698	112.948	-208.599	88.501	-3.335
5900	21.660	64.542	45.031	115.114	-208.516	95.119	-3.523
6000	21.660	64.906	45.359	117.280	-208.436	101.728	-3.705

15 September 1963

HLS

15 September 1963

HLS

SILICON DIOXIDE (SiO₂)

(CONDENSED PHASE)

gfw = 60.09

$$\Delta H_{f, 298.15}^{\circ} = -218.0 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 10.00 \pm 0.10 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$T_t = 848^{\circ}\text{K}$$

$$\Delta H_t = 0.290 \text{ kcal gfw}^{-1}$$

$$T_t = 1298^{\circ}\text{K}$$

$$\Delta H_t = 0.180 \text{ kcal gfw}^{-1}$$

$$T_m = 1996^{\circ}\text{K}$$

$$\Delta H_m = 2.100 \text{ kcal gfw}^{-1}$$

$$H_{298.15} - H_0^{\circ} = 1.664 \text{ cal gfw}^{-1}$$

$$C_p^{\circ} = 11.22 + 8.20 \times 10^{-3}T - 2.70 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 848^{\circ}\text{K}$$

$$C_p^{\circ} = 14.41 + 1.94 \times 10^{-3}T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 848^{\circ}\text{K} \leq T \leq 1298^{\circ}$$

$$C_p^{\circ} = 14.40 + 2.04 \times 10^{-3}T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1298^{\circ}\text{K} \leq T \leq 1996^{\circ}\text{K}$$

$$C_p^{\circ} = 21.66 \text{ deg K}^{-1} \text{ gfw}^{-1} \quad 1996^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

The stable forms of SiO₂ are considered to be: α -quartz (hexagonal) up to 848°K; β -quartz (hexagonal) up to 1298°K, β -cristobalite (cubic) up to 1996°K

Heat of Formation

Average of calorimetric values by Golutvin¹, Wise, et al², Good, et al³

Heat Capacity and Entropy

Low-temperature data⁶ from Anderson⁴ and Kelley and King⁵ High-temperature data from Kelley.⁶ Data above melting point from Schick.⁷

Melting and Vaporization

Heat of fusion was an average value from Schick.⁷

References

1. Golutvin, Yu, Zh. Fiz. Khim. 30, 2251 (1956)
2. Wises, et al, S. S. J. Phys. Chem. 67, 815 (1963).
3. Good, W., et al, J. Phys. Chem. 66, 380 (1962)
4. Anderson, C. T., J. Am. Chem. Soc. 58, 568 (1936)
5. Kelley, K. K., King, E. G., Bur. Mines Bull. 592 (1961).
6. Kelley, K. K., Bur. of Mines Bull., 584 (1960).
7. Schick, H., Chem. Revs. 60, (1963).

SILICON DIOXIDE (SiO₂)

(CONDENSED PHASE)

GFW = 60.09

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/ K gfw			Kcal/gfw			log K _p
	C _p	S _T	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH_t	ΔF_t	
298.15	±0.100	±0.100	±0.100	±0.000	±0.500		
848	±0.100	±0.205	±0.140	±0.055			
848	±0.200	±0.240	±0.140	±0.085			
1000	±0.200	±0.273	±0.157	±0.115			
1298	±0.200	±0.325	±0.190	±0.175			
1298	±0.200	±0.364	±0.190	±0.225			
1996	±0.200	±0.450	±0.267	±0.365			
1996	±1.000	±0.951	±0.267	±1.365			
2000	±1.000	±0.953	±0.268	±1.369			
3000	±1.000	±1.358	±0.569	±2.369			
4000	±1.000	±1.646	±0.804	±3.369			
5000	±1.000	±1.869	±0.995	±4.369			
6000	±1.000	±2.051	±1.156	±5.369			

TABLE 200
SILICON DIOXIDE IDEAL MOLECULAR GAS

O₂Si

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Si from 0° to 1690°K, Liquid Si from 1690° to 3566°K, Gaseous Si from 3566° to 6000°K, Gaseous O₂; Gaseous SiO₂.

T, °K	$\int_0^T \frac{C_p}{T^2} dT$	$\int_0^T \frac{C_v}{T^2} dT$	$-(F_T - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.517	-77.106	-77.106	INFINITE
298.15	10.467	54.526	54.526	0.000	-77.433	-77.728	56.973
300	10.486	54.590	54.526	0.019	-77.436	-77.730	56.623
400	11.425	57.741	54.949	1.117	-77.556	-77.809	42.511
500	12.162	60.373	55.778	2.298	-77.655	-77.860	34.031
600	12.727	62.643	56.737	3.543	-77.740	-77.893	28.371
700	13.154	64.638	57.726	4.838	-77.813	-77.912	24.324
800	13.477	66.417	58.703	6.171	-77.883	-77.923	21.286
900	13.724	68.019	59.651	7.531	-77.954	-77.923	18.922
1000	13.916	69.475	60.561	8.914	-78.028	-77.914	17.027
1100	14.066	70.809	61.433	10.313	-78.107	-77.899	15.476
1200	14.186	72.038	62.266	11.726	-78.191	-77.877	14.183
1300	14.283	73.178	63.063	13.150	-78.282	-77.849	13.087
1400	14.362	74.239	63.823	14.582	-78.381	-77.811	12.146
1500	14.427	75.232	64.551	16.022	-78.488	-77.766	11.330
1600	14.481	76.165	65.248	17.467	-78.605	-77.715	10.615
1690	14.523	76.959	65.851	18.772	-78.719	-77.663	10.043
1700	14.527	76.959	65.851	18.772	-90.668	-77.663	10.043
1800	14.566	77.876	66.558	18.917	-90.681	-77.586	9.974
1900	14.599	78.664	67.175	20.372	-90.818	-76.810	9.326
2000	14.627	79.414	67.768	21.830	-90.965	-76.029	8.745
2100	14.652	80.128	68.340	23.292	-91.120	-75.237	8.221
2200	14.674	80.810	68.891	24.756	-91.277	-74.440	7.747
2300	14.693	81.463	69.424	26.222	-91.438	-73.634	7.314
2400	14.710	82.089	69.938	27.690	-91.601	-72.824	6.920
2500	14.725	82.689	70.437	29.161	-91.768	-72.002	6.556
2600	14.738	83.267	70.919	30.632	-91.940	-71.178	6.222
2700	14.750	83.824	71.387	32.105	-92.115	-70.340	5.912
2800	14.760	84.360	71.841	33.580	-92.293	-69.503	5.626
2900	14.770	84.878	72.281	35.055	-92.476	-68.655	5.359
3000	14.778	85.379	72.710	36.532	-92.662	-67.799	5.109
3100	14.786	85.864	73.126	38.009	-92.853	-66.939	4.876
3200	14.793	86.334	73.532	39.487	-93.047	-66.068	4.658
3300	14.800	86.789	73.926	40.966	-93.246	-65.199	4.453
3400	14.806	87.231	74.311	42.446	-93.446	-64.315	4.259
3500	14.811	87.660	74.687	43.926	-93.647	-63.428	4.077
3566.77	14.815	87.936	74.928	45.407	-93.853	-62.537	3.905
3566.77	14.815	87.936	74.928	46.382	-93.998	-61.943	3.796
3600	14.816	88.077	75.053	46.382	-115.493	-61.943	3.796
3700	14.821	88.483	75.410	46.889	-185.509	-60.761	3.689
3800	14.825	88.879	75.760	48.371	-185.559	-57.294	3.384
3900	14.829	89.264	76.101	49.853	-185.614	-53.827	3.096
4000	14.833	89.639	76.435	51.336	-185.672	-50.359	2.822
4100	14.836	90.006	76.761	52.819	-185.732	-46.885	2.562
4200	14.840	90.363	77.081	54.302	-185.798	-43.415	2.314
4300	14.843	90.712	77.394	55.786	-185.866	-39.935	2.078
4400	14.845	91.054	77.700	57.270	-185.937	-36.463	1.853
4500	14.848	91.387	78.001	58.755	-186.012	-32.980	1.638
4600	14.850	91.714	78.295	60.239	-186.091	-29.503	1.433
4700	14.853	92.033	78.584	61.724	-186.175	-26.019	1.236
4800	14.855	92.346	78.868	63.209	-186.262	-22.537	1.048
4900	14.857	92.652	79.146	64.695	-186.355	-19.055	0.868
5000	14.859	92.952	79.419	66.180	-186.455	-15.566	0.694
5100	14.860	93.247	79.687	67.666	-186.561	-12.073	0.528
5200	14.862	93.535	79.951	69.152	-186.677	-8.578	0.368
5300	14.864	93.818	80.210	70.638	-186.802	-5.085	0.214
5400	14.865	94.096	80.464	72.124	-186.940	-1.590	0.066
5500	14.866	94.369	80.715	73.611	-187.091	1.915	-0.077
5600	14.868	94.637	80.961	75.097	-187.261	5.419	-0.215
5700	14.869	94.900	81.203	76.584	-187.452	8.925	-0.348
5800	14.870	95.159	81.442	78.071	-187.668	12.433	-0.477
5900	14.871	95.413	81.676	79.558	-187.916	15.953	-0.601
6000	14.873	95.663	81.907	81.045	-188.201	19.480	-0.722
				82.532	-188.530	23.007	-0.838

15 September 1963

HLS

SILICON DIOXIDE (SiO₂)

(IDEAL MOLECULAR GAS)

gfw = 60.09

$$\Delta H_{f0}^{\circ} = -77.106 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -77.433 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S_{298.15}^{\circ} = 54.526 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.517 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

ω, cm^{-1}	ω, cm^{-1}
990.9 (1)	1449.3 (1)
377.9 (2)	

Bond lengths and angles:

Si-O distance = 1.509 Å

O-Si-O angle = 180°

Moment of inertia:

$$I = 12.0976 \times 10^{-39} \text{ gm cm}^2$$

$$B_e = 0.23135 \text{ cm}^{-1}$$

Heat of Formation

Vapor-pressure data of Porter *et al*¹ was used. Results in general agreement with earlier analyses by Schick² and Brewer and Rosenblatt.³

Heat Capacity and Entropy

Estimated values for spectroscopic constants were used.

References

1. Porter, R., *et al*, J. Chem. Phys. **23**, 216 (1955).
2. Schick, H., Chem. Revs. **60**, 331 (1960).
3. Brewer, L., and G. Rosenblatt, Chem. Revs. **61**, 257 (1961).

SILICON DIOXIDE (SiO₂)

(IDEAL MOLECULAR GAS)

GFW = 60.09

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	log K _p
298.15	±1.000	±1.000	±1.000	±0.000	±5.000		
1000	±1.000	±2.210	±1.508	±0.702			
2000	±1.000	±2.903	±2.052	±1.702			
3000	±1.000	±3.309	±2.408	±2.702			
4000	±1.000	±3.596	±2.671	±3.702			
5000	±1.000	±3.820	±2.879	±4.702			
6000	±1.000	±4.002	±3.052	±5.702			

TABLE 201

TANTALUM DIOXIDE

IDEAL MOLECULAR GAS

O₂Ta

Reference State for Calculating M_f° , ΔF_f° , and $\log K_p$: Solid Ta from 0° to 3270°K, Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K; Gaseous O₂; Gaseous TaO₂.

T, °K	C_p	S_T°	$-(H_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.675	-45.950	-45.950	INFINITE
298.15	11.071	62.527	62.527	0.000	-46.708	-47.781	35.023
300	11.091	62.595	62.527	0.020	-46.712	-47.788	34.812
400	12.022	65.919	62.974	1.178	-46.883	-48.120	26.290
500	12.725	68.681	63.847	2.417	-47.008	-48.413	21.161
600	13.231	71.048	64.854	3.716	-47.107	-48.684	17.732
700	13.594	73.117	65.890	5.059	-47.190	-48.941	15.279
800	13.862	74.950	66.910	6.432	-47.271	-49.186	13.436
900	14.068	76.595	67.897	7.829	-47.348	-49.421	12.000
1000	14.235	78.086	68.842	9.244	-47.427	-49.646	10.850
1100	14.380	79.450	69.745	10.675	-47.504	-49.864	9.907
1200	14.513	80.707	70.607	12.120	-47.582	-50.075	9.120
1300	14.639	81.874	71.430	13.578	-47.660	-50.282	8.453
1400	14.761	82.963	72.215	15.048	-47.739	-50.480	7.880
1500	14.881	83.986	72.966	16.530	-47.820	-50.672	7.383
1600	14.999	84.950	73.685	18.024	-47.902	-50.860	6.947
1700	15.113	85.863	74.375	19.529	-47.986	-51.043	6.562
1800	15.223	86.730	75.037	21.046	-48.073	-51.219	6.219
1900	15.328	87.555	75.675	22.574	-48.162	-51.393	5.911
2000	15.426	88.344	76.288	24.112	-48.259	-51.558	5.634
2100	15.518	89.099	76.881	25.659	-48.364	-51.723	5.383
2200	15.607	89.823	77.453	27.215	-48.477	-51.878	5.153
2300	15.678	90.518	78.006	28.779	-48.603	-52.030	4.944
2400	15.746	91.187	78.541	30.350	-48.744	-52.178	4.751
2500	15.806	91.831	79.060	31.928	-48.908	-52.318	4.573
2600	15.859	92.452	79.563	33.511	-49.090	-52.449	4.409
2700	15.904	93.051	80.052	35.099	-49.307	-52.575	4.255
2800	15.942	93.630	80.526	36.692	-49.563	-52.692	4.113
2900	15.974	94.190	80.988	38.288	-49.873	-52.798	3.979
3000	16.000	94.732	81.437	39.886	-50.247	-52.894	3.853
3100	16.019	95.257	81.874	41.487	-50.692	-52.970	3.734
3200	16.034	95.766	82.301	43.090	-51.217	-53.041	3.622
3270	16.042	96.113	82.593	44.213	-51.634	-53.075	3.547
3270	16.042	96.113	82.593	44.213	-51.634	-53.075	3.547
3300	16.044	96.260	82.716	44.694	-51.839	-53.024	3.511
3400	16.050	96.739	83.122	46.299	-52.611	-52.862	3.398
3500	16.052	97.204	83.517	47.904	-53.837	-52.682	3.289
3600	16.051	97.656	83.904	49.509	-55.055	-52.508	3.187
3700	16.047	98.096	84.281	51.114	-56.281	-52.321	3.090
3800	16.041	98.524	84.651	52.718	-57.512	-52.131	2.998
3900	16.032	98.940	85.012	54.322	-58.747	-51.934	2.910
4000	16.021	99.346	85.365	55.925	-59.986	-51.728	2.826
4100	16.009	99.742	85.711	57.526	-60.231	-51.521	2.746
4200	15.995	100.127	86.050	59.126	-60.481	-51.303	2.669
4300	15.980	100.503	86.381	60.725	-60.735	-51.077	2.596
4400	15.964	100.871	86.707	62.322	-60.996	-50.853	2.526
4500	15.948	101.229	87.025	63.918	-61.261	-50.618	2.458
4600	15.931	101.580	87.338	65.512	-61.533	-50.374	2.393
4700	15.913	101.922	87.645	67.104	-61.812	-50.130	2.331
4800	15.895	102.257	87.945	68.695	-62.098	-49.871	2.271
4900	15.877	102.584	88.241	70.283	-62.393	-49.619	2.213
5000	15.858	102.904	88.531	71.870	-62.697	-49.353	2.157
5100	15.840	103.219	88.816	73.455	-63.012	-49.080	2.103
5200	15.821	103.526	89.096	75.036	-63.339	-48.804	2.051
5300	15.803	103.827	89.371	76.619	-63.681	-48.521	2.001
5400	15.784	104.123	89.641	78.198	-64.040	-48.225	1.952
5500	15.766	104.412	89.907	79.776	-64.417	-47.923	1.904
5600	15.748	104.696	90.169	81.352	-64.818	-47.621	1.858
5700	15.731	104.975	90.426	82.926	-65.246	-47.306	1.814
5706.65	15.729	104.993	90.443	83.030	-65.276	-47.284	1.811
5706.65	15.729	104.993	90.443	83.030	-246.499	-47.284	1.811
5800	15.713	105.248	90.679	84.498	-247.084	-44.017	1.659
5900	15.696	105.516	90.929	86.068	-247.753	-40.513	1.501
6000	15.679	105.780	91.174	87.637	-248.470	-36.982	1.347

15 September 1963

HLS

TANTALUM DIOXIDE (TaO₂) (IDEAL MOLECULAR GAS) gfw = 212.95

$$\Delta H_{f0}^{\circ} = -45.950 \text{ kcal. gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -46.708 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S_{298.15}^{\circ} = 62.527 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.675 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

ω, cm^{-1}	ω, cm^{-1}
988.9 (1)	1072.8 (1)
279.7 (2)	

Bond lengths and angles:

Ta - O distance = 1.687 Å

O-Ta-O angle = 180°

Moments of inertia

$$I = 15.12 \times 10^{-39} \text{ gm cm}^2$$

$$\sigma = 2$$

$$B_e = 0.185111 \text{ cm}^{-1}$$

Heat of Formation

Vaporization data of Inghram et al.¹ was used.

Heat Capacity and Entropy

Spectroscopic constants were estimated. See volume 1, this study (section IVB27.4.2) for details.

Reference

1. Inghram, M., W. Chupka, and J. Berkowitz, J. Chem. Phys. **27**, 569 (1957)

TANTALUM DIOXIDE (TaO₂) (IDEAL MOLECULAR GAS) GFW = 212.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±1.000	±3.000	±3.000	±0.000	±10.000		
1000	±1.000	±4.210	±3.508	±0.702			
2000	±1.000	±4.903	±4.052	±1.702			
3000	±1.000	±5.309	±4.408	±2.702			
4000	±1.000	±5.596	±4.671	±3.702			
5000	±1.000	±5.820	±4.879	±4.702			
6000	±1.000	±6.002	±5.052	±5.702			

TABLE 202

TITANIUM DIOXIDE

CONDENSED PHASE

O₂Ti

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Ti from 0° to 1950°K,
 Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K; Gaseous O₂:
 Solid TiO₂ from 0° to 2143°K, Liquid TiO₂ from 2143° to 6000°K.

T, °K	C_p	$\frac{\text{cal/}^\circ\text{K gfw}}{T}$	$\frac{-(F_T^\circ - H_{298}^\circ)/T}{T}$	$\frac{\text{Kcal/gfw}}{H_T^\circ - H_{298}^\circ}$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-7.064	-224.639	-224.639	INFINITE
298.15	13.160	12.040	12.040	0.000	-225.800	-212.593	155.827
300	13.221	12.122	12.040	0.024	-225.800	-212.511	154.807
400	15.363	16.262	12.590	1.469	-225.685	-208.094	113.692
500	16.370	19.810	13.689	3.061	-225.473	-203.720	89.042
600	16.930	22.849	14.969	4.728	-225.235	-199.392	72.625
700	17.278	25.487	16.287	6.440	-224.994	-195.104	60.911
800	17.514	27.810	17.585	8.180	-224.762	-190.850	52.135
900	17.685	29.884	18.838	9.941	-224.540	-186.623	45.316
1000	17.815	31.754	20.038	11.716	-224.333	-182.421	39.866
1100	17.918	33.457	21.182	13.503	-224.139	-178.240	35.411
1155	17.967	34.332	21.787	14.490	-224.037	-175.947	33.291
1155	17.967	34.332	21.787	14.490	-224.987	-175.947	33.291
1200	18.004	35.020	22.271	15.299	-224.907	-174.038	31.695
1300	18.077	36.464	23.308	17.103	-224.738	-169.808	28.546
1400	18.140	37.806	24.296	18.914	-224.581	-165.587	25.848
1500	18.197	39.059	25.239	20.731	-224.434	-161.379	23.512
1600	18.248	40.235	26.140	22.553	-224.300	-157.181	21.469
1700	18.295	41.343	27.002	24.380	-224.177	-152.989	19.667
1800	18.340	42.390	27.828	26.212	-224.065	-148.805	18.067
1900	18.382	43.383	28.620	28.048	-223.964	-144.624	16.635
1950	18.402	43.860	29.005	28.968	-223.917	-142.537	15.974
1950	18.402	43.860	29.005	28.968	-227.617	-142.537	15.974
2000	18.421	44.327	29.382	29.888	-227.549	-140.356	15.337
2100	18.459	45.226	30.116	31.732	-227.411	-136.002	14.153
2143	18.475	45.601	30.423	32.526	-227.352	-134.131	13.678
2143	18.475	52.600	30.423	47.526	-212.352	-134.131	13.678
2700	18.475	53.085	31.003	48.580	-212.274	-132.049	13.117
2300	18.475	53.906	31.982	50.427	-212.143	-128.409	12.201
2400	18.475	54.693	32.912	52.275	-212.017	-124.770	11.361
2500	18.475	55.447	33.798	54.122	-211.898	-121.138	10.589
2600	18.475	56.171	34.645	55.970	-211.782	-117.507	9.877
2700	18.475	56.869	35.455	57.817	-211.673	-113.885	9.218
2800	18.475	57.541	36.232	59.665	-211.567	-110.264	8.606
2900	18.475	58.189	36.978	61.512	-211.461	-106.648	8.037
3000	18.475	58.815	37.695	63.360	-211.355	-103.034	7.506
3100	18.475	59.421	38.386	65.207	-211.282	-99.422	7.009
3200	18.475	60.008	39.053	67.055	-211.196	-95.819	6.544
3300	18.475	60.576	39.697	68.902	-211.114	-92.213	6.107
3400	18.475	61.128	40.319	70.750	-211.036	-88.610	5.696
3500	18.475	61.663	40.921	72.597	-210.963	-85.009	5.308
3550	18.475	61.925	41.215	73.521	-210.927	-83.211	5.122
3550	18.475	61.925	41.215	73.521	-313.384	-83.211	5.122
3600	18.475	62.184	41.505	74.445	-313.355	-79.971	4.855
3700	18.475	62.690	42.070	76.292	-313.309	-73.486	4.340
3800	18.475	63.182	42.619	78.140	-313.280	-67.002	3.853
3900	18.475	63.662	43.153	79.987	-313.270	-60.526	3.392
4000	18.475	64.130	43.671	81.835	-313.274	-54.040	2.952
4100	18.475	64.586	44.176	83.682	-313.296	-47.561	2.535
4200	18.475	65.032	44.667	85.530	-313.333	-41.076	2.137
4300	18.475	65.466	45.146	87.377	-313.386	-34.592	1.758
4400	18.475	65.891	45.613	89.225	-313.454	-28.108	1.396
4500	18.475	66.306	46.068	91.072	-313.537	-21.626	1.050
4600	18.475	66.712	46.512	92.920	-313.634	-15.129	0.719
4700	18.475	67.110	46.946	94.767	-313.748	-8.641	0.402
4800	18.475	67.499	47.370	96.615	-313.876	-2.144	0.098
4900	18.475	67.879	47.785	98.462	-314.020	4.353	-0.194
5000	18.475	68.253	48.191	100.310	-314.179	10.850	-0.474
5100	18.475	68.619	48.588	102.157	-314.357	17.353	-0.744
5200	18.475	68.977	48.976	104.005	-314.551	23.862	-1.003
5300	18.475	69.329	49.357	105.852	-314.766	30.375	-1.252
5400	18.475	69.675	49.730	107.700	-315.002	36.888	-1.493
5500	18.475	70.014	50.096	109.547	-315.262	43.414	-1.725
5600	18.475	70.346	50.455	111.395	-315.549	49.933	-1.949
5700	18.475	70.671	50.806	113.242	-315.867	56.475	-2.165
5800	18.475	70.995	51.147	115.090	-316.221	63.011	-2.374
5900	18.475	71.311	51.491	116.937	-316.617	69.560	-2.577
6000	18.475	71.621	51.824	118.785	-317.060	76.114	-2.772

15 September 1961

HLS

TITANIUM DIOXIDE (TiO₂)

(CONDENSED PHASE)

gfw = 79.90

$$\Delta H_{f298.15}^{\circ} = -225.8 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 12.04 \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2143^{\circ}\text{K}$$

$$\Delta H_m = 15.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.064 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 17.97 + 0.28 \times 10^{-3}T - 4.35 \times 10^{-5}T^2 \text{ cal deg}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 2143^{\circ}\text{K}$$

$$C_p^{\circ} = 18.475 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 2143^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

The stable form of TiO₂ is rutile with a tetragonal structure.

Heat of Formation

Based on combustion data of Mah et al¹ and agreeing with Humphrey,² and Ariya et al³.

Heat Capacity and Entropy

Low-temperature data based on Kelley and King analysis.⁴ High-temperature data from Kelley.⁵ Data above melting point is estimated.

Melting and Vaporization

Melting point is from Brauer and Littke.⁶ Heat of fusion was estimated.

References

1. Mah, A. et al, Bur. of Mines Rept. 5316 (1957).
2. Humphrey, G. L., J. Am. Chem. Soc. 73, 1587 (1951).
3. Ariya, S., et al, J. Inorg. Chem. (Russia) 3, 13 (1957).
4. Kelley, K., E. G. King., Bur. of Mines Bull. 592 (1961).
5. Kelley, K., Bur. of Mines Bull. 584 (1960).
6. Brauer, G., W. J. Littke., J. Inorg. Nucl. Chem. 16, 67 (1960).

TITANIUM DIOXIDE (TiO₂)

(CONDENSED PHASE)

GFW = 79.90

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±0.200	±0.040	±0.040	±0.000	±1.000		
1000	±0.200	±0.282	±0.142	±0.140			
2000	±0.200	±0.421	±0.250	±0.340			
2143	±0.200	±0.434	±0.262	±0.369			
2143	±2.000	±2.768	±0.262	±5.369			
3000	±2.000	±3.440	±1.079	±7.083			
4000	±2.000	±4.016	±1.745	±9.083			
5000	±2.000	±4.462	±2.246	±11.083			
6000	±2.000	±4.827	±2.646	±13.083			

TABLE 201

TITANIUM DIOXIDE

IDEAL MOLECULAR GAS

O₂Ti

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K, Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K; Gaseous O₂, Gaseous TiO₂.

T, °K	C_p	C_p	$-(F_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.662	-82.327	-82.327	INFINITE
298.15	11.120	56.562	56.562	0.000	-82.890	-82.957	60.806
300	11.140	56.631	56.562	0.021	-82.893	-82.957	60.432
400	12.091	59.972	57.011	1.184	-83.060	-82.953	45.321
500	12.788	62.749	57.889	2.430	-83.194	-82.910	36.238
600	13.283	65.127	58.902	3.735	-83.318	-82.841	30.174
700	13.635	67.203	59.942	5.082	-83.442	-82.752	25.835
800	13.889	69.041	60.967	6.459	-83.573	-82.645	22.577
900	14.078	70.688	61.957	7.858	-83.713	-82.520	20.038
1000	14.220	72.179	62.906	9.273	-83.866	-82.379	18.003
1100	14.329	73.540	63.812	10.701	-84.031	-82.223	16.335
1155	14.378	74.240	64.292	11.490	-84.127	-82.130	15.540
1154	14.378	74.240	64.292	11.490	-85.077	-82.130	15.540
1200	14.415	74.790	64.675	12.138	-85.158	-82.013	14.936
1300	14.483	75.947	65.498	13.583	-85.348	-81.745	13.742
1400	14.538	77.022	66.284	15.034	-85.551	-81.461	12.716
1500	14.583	78.027	67.033	16.490	-85.765	-81.160	11.825
1600	14.620	78.969	67.750	17.950	-85.993	-80.847	11.043
1700	14.652	79.856	68.436	19.414	-86.233	-80.517	10.351
1800	14.678	80.695	69.094	20.881	-86.486	-80.174	9.734
1900	14.701	81.489	69.726	22.349	-86.753	-79.816	9.180
1950	14.711	81.871	70.033	23.085	-86.890	-79.632	8.924
1950	14.711	81.871	70.033	23.085	-90.590	-79.632	8.924
2000	14.720	82.243	70.333	23.821	-90.706	-79.348	8.670
2100	14.737	82.962	70.918	25.293	-90.940	-78.776	8.198
2200	14.751	83.648	71.481	26.768	-91.176	-78.191	7.767
2300	14.764	84.304	72.024	28.244	-91.416	-77.595	7.373
2400	14.775	84.933	72.549	29.721	-91.661	-76.988	7.010
2500	14.785	85.536	73.056	31.199	-91.911	-76.372	6.676
2600	14.794	86.116	73.548	32.678	-92.164	-75.745	6.367
2700	14.802	86.674	74.024	34.157	-92.423	-75.111	6.080
2800	14.809	87.213	74.485	35.638	-92.694	-74.462	5.812
2900	14.816	87.733	74.933	37.119	-92.951	-73.807	5.562
3000	14.821	88.235	75.368	38.601	-93.221	-73.143	5.328
3100	14.827	88.721	75.791	40.084	-93.495	-72.468	5.109
3200	14.831	89.192	76.202	41.566	-93.771	-71.786	4.903
3300	14.836	89.648	76.603	43.050	-94.051	-71.092	4.708
3400	14.840	90.091	76.993	44.534	-94.34	-70.392	4.525
3500	14.843	90.522	77.374	46.018	-94.632	-69.684	4.351
3550	14.845	90.732	77.560	46.760	-94.778	-69.325	4.268
3550	14.845	90.732	77.560	46.760	-197.235	-69.325	4.268
3600	14.847	90.940	77.745	47.502	-197.388	-67.525	4.099
3700	14.850	91.347	78.107	48.987	-197.704	-63.913	3.775
3800	14.852	91.743	78.460	50.472	-198.038	-60.288	3.467
3900	14.855	92.128	78.806	51.957	-198.390	-56.662	3.175
4000	14.857	92.505	79.144	53.443	-198.756	-53.022	2.897
4100	14.860	92.871	79.474	54.929	-199.139	-49.373	2.632
4200	14.862	93.230	79.797	56.415	-199.538	-45.712	2.379
4300	14.864	93.579	80.114	57.901	-199.952	-42.044	2.137
4400	14.866	93.921	80.424	59.388	-200.381	-38.366	1.906
4500	14.867	94.255	80.727	60.874	-200.825	-34.681	1.684
4600	14.869	94.582	81.025	62.361	-201.283	-30.979	1.472
4700	14.870	94.902	81.317	63.848	-201.757	-27.275	1.268
4800	14.872	95.215	81.603	65.335	-202.246	-23.552	1.072
4900	14.873	95.521	81.884	66.823	-202.749	-19.822	0.884
5000	14.874	95.822	82.160	68.310	-203.269	-16.085	0.703
5100	14.875	96.117	82.431	69.797	-203.807	-12.337	0.529
5200	14.877	96.405	82.697	71.285	-204.361	-8.577	0.360
5300	14.878	96.689	82.958	72.773	-204.935	-4.800	0.198
5400	14.879	96.967	83.215	74.261	-205.531	-1.021	0.041
5500	14.880	97.240	83.467	75.748	-206.151	2.784	-0.111
5600	14.880	97.508	83.716	77.236	-206.798	6.581	-0.257
5700	14.881	97.771	83.960	78.724	-207.475	10.408	-0.399
5800	14.882	98.030	84.200	80.213	-208.188	14.243	-0.537
5900	14.883	98.285	84.437	81.701	-208.943	18.088	-0.670
6000	14.883	98.535	84.670	83.189	-209.746	21.948	-0.799

15 September 1963

HLS

TITANIUM DIOXIDE (TiO₂) (IDEAL MOLECULAR GAS) gfw = 79.90

$$\Delta H_{f0}^{\circ} = -82.327 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -82.890 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S_{298.15}^{\circ} = 56.562 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.662 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

ω , cm ⁻¹	ω , cm ⁻¹
873.2 (1)	1127.8 (1)
294.1 (2)	

Bond lengths and angles:

$$\text{O-Ti distance} = 1.620 \text{ \AA}$$

$$\text{O-Ti-O angle} = 180^{\circ}$$

Moments of inertia:

$$I = 13.9429 \times 10^{-39} \text{ gcm}^2$$

$$\sigma = 2$$

$$B_e = 0.20074 \text{ cm}^{-1}$$

Heat of Formation

Vaporization data of Berkowitz et al¹ was recalculated.

Heat Capacity and Entropy

Estimated spectroscopic constants were used.

Reference

1. Berkowitz, J., et al, J. Phys. Chem. 61 1569 (1957)

TITANIUM DIOXIDE (TiO₂) (IDEAL MOLECULAR GAS)

GFW = 79.90

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±1.000	±3.000	±3.000	±0.000	±5.000		
1000	±1.000	±4.210	±3.508	±0.702			
2000	±1.000	±4.903	±4.052	±1.702			
3000	±1.000	±5.309	±4.408	±2.702			
4000	±1.000	±5.596	±4.671	±3.702			
5000	±1.000	±5.820	±4.879	±4.702			
6000	±1.000	±6.002	±5.052	±5.702			

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid U from 0° to 1406°K,
Liquid U from 1406° to 4124°K, Gaseous U from 4124° to 6000°K,
Gaseous O₂; Solid UO₂ from 0° to 3000°K.

T, °K	$\left(\frac{C_p}{R}\right)$	$\left(\frac{C_p}{R}\right)$	$-\left(F_f^\circ - H_{298}^\circ\right)/T$	$H_f^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
U	0.000	0.000	INFINITE	-2.726	-238.330	-238.330	INFINITE
298.15	15.350	10.029	10.029	0.000	-239.200	-240.300	100.727
300	15.360	10.724	10.031	0.028	-239.177	-240.449	179.550
400	17.373	23.445	17.260	1.074	-238.740	-242.200	132.373
500	18.426	27.446	20.708	3.469	-238.013	-238.137	104.074
600	19.572	30.067	21.950	5.346	-238.279	-234.100	85.267
700	19.526	33.042	23.440	7.277	-237.982	-230.094	71.833
800	19.877	36.474	24.913	9.248	-237.755	-226.127	61.772
900	20.169	38.832	26.331	11.231	-237.617	-222.182	53.951
940	20.275	39.711	26.882	12.060	-237.539	-220.608	51.289
940	20.275	39.711	26.882	12.060	-238.278	-220.608	51.289
1000	20.424	40.971	27.090	13.281	-238.104	-218.207	47.687
1048	20.537	41.931	28.320	14.264	-238.009	-216.291	45.103
1048	20.537	41.931	28.320	14.264	-239.189	-216.291	45.103
1100	20.655	42.920	29.387	15.333	-239.032	-214.160	42.549
1200	20.869	44.735	30.223	17.411	-238.719	-210.101	38.203
1300	21.072	46.413	31.407	19.308	-238.394	-206.006	34.044
1400	21.266	47.982	32.333	21.023	-238.030	-202.001	31.540
1406	21.277	48.073	32.601	21.733	-238.033	-201.812	31.368
1500	21.434	49.455	33.613	23.761	-237.733	-201.812	31.368
1600	21.637	50.046	34.047	25.916	-237.342	-199.431	28.811
1700	21.817	52.163	35.040	28.088	-236.867	-197.176	26.423
1800	21.974	53.415	36.333	30.279	-236.301	-194.922	24.317
1900	22.155	54.800	37.310	32.487	-235.682	-192.671	22.432
2000	22.341	55.750	38.394	34.713	-235.047	-190.470	20.703
2100	22.512	56.845	39.247	36.953	-234.393	-188.291	19.230
2200	22.682	57.896	40.071	39.213	-233.716	-186.120	17.900
2300	22.851	58.908	40.850	41.492	-233.020	-183.973	16.580
2400	23.017	59.884	41.640	43.785	-232.314	-181.843	15.533
2500	23.167	60.827	42.387	46.096	-231.596	-179.734	14.561
2600	23.353	61.740	43.110	48.423	-230.866	-177.642	13.674
2700	23.520	62.624	43.822	50.760	-230.120	-175.574	12.844
2800	23.685	63.482	44.507	53.126	-229.373	-173.534	12.061
2900	23.851	64.317	45.177	55.523	-228.621	-171.511	11.311
3000	24.016	65.128	45.827	57.897	-227.861	-169.502	10.588

$$\Delta H_{f298.15}^\circ = -259.2 \pm 0.6 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^\circ = 18.63 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

T_m = Uncertain. See volume 1, this study (section IVB32.4.2).

$$H_{298.15}^\circ - H_0^\circ = 2.726 \text{ kcal gfw}^{-1}$$

C_p° data have been selected and smoothed (see below).

Structure

Face-centered-cubic CaF₄-type.

Heat of Formation

Taken from Coughlin.¹

Heat Capacity and Entropy

Low-temperature data are from Jones, Gordon, and Long² joined to Kelley's equation.³

Melting and Vaporization

See volume 1, this study (section IVB32.4.2).

References

1. Coughlin, V. P., U.S. Bur. Mines, Bull. 542 (1954).
2. Jones, W. M., J. Gordon, and E. A. Long, J. Chem. Phys. 20, 695 (1952).
3. Kelley, K. K., U.S. Bur. Mines, Bull. 584 (1960).

URANIUM DIOXIDE (UO₂)

(CONDENSED PHASE)

GFW = 270.07

SUMMARY OF UNCERTAINTY ESTIMATES

T °K	cal. °K gfw			Kcal/gfw			Log K _p
	C_p°	S_1°	$-(F_1^\circ - H_{298}^\circ)/T$	$H_1^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
298.15	* 0.200	* 0.100	* 0.100	* 0.000	* 0.600		
500	* 0.200	* 0.203	* 0.123	* 0.040			
500	* 0.500	* 0.203	* 0.123	* 0.040			
1000	* 0.500	* 0.550	* 0.260	* 0.290			
2000	* 0.500	* 0.897	* 0.501	* 0.790			
2000	* 1.000	* 0.897	* 0.501	* 0.790			
3000	* 1.000	* 1.302	* 0.705	* 1.790			

URANIUM DIOXIDE

TABLE 205
IDEAL MOLECULAR GASO₂U

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid U from 0° to 1406°K,
Liquid U from 1406° to 4124°K, Gaseous U from 4124° to 6000°K;
Gaseous O₂, Gaseous UO₂

T, °K	C _p	ΔH_f°	$(F_f^\circ - H_{298}^\circ)/T$	$H_f^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.629	-116.033	-116.033	INFINITE
298.15	10.386	68.200	68.200	0.000	-117.000	-119.146	87.332
300	10.406	68.265	68.201	0.019	-117.006	-119.160	86.804
400	11.362	71.396	68.621	1.110	-117.310	-119.831	65.469
500	12.036	74.009	69.445	2.282	-117.600	-120.427	52.636
600	12.497	76.247	70.396	3.510	-117.915	-120.964	44.059
700	12.817	78.198	71.374	4.777	-118.282	-121.444	37.915
800	13.044	79.926	72.337	6.071	-118.732	-121.866	33.291
900	13.209	81.472	73.268	7.384	-119.284	-122.225	29.679
940	13.262	82.047	73.629	7.913	-119.540	-122.350	28.445
940	13.262	82.047	73.629	7.913	-120.225	-122.350	28.445
1000	13.332	82.870	74.159	8.711	-120.534	-122.476	26.766
1048	13.380	83.496	74.573	9.352	-120.781	-122.564	25.558
1048	13.380	83.496	74.573	9.352	-121.901	-122.564	25.558
1100	13.426	84.146	75.010	10.049	-122.118	-122.591	24.355
1200	13.499	85.317	75.821	11.395	-122.535	-122.616	22.330
1300	13.557	86.400	76.594	12.748	-123.054	-122.607	20.611
1400	13.604	87.406	77.330	14.106	-123.575	-122.564	19.132
1406	13.607	87.465	77.373	14.188	-123.400	-122.561	19.050
1406	13.607	87.465	77.373	14.188	-128.100	-122.561	19.050
1500	13.642	88.346	78.034	15.469	-128.497	-122.178	17.800
1600	13.674	89.228	78.706	16.835	-128.923	-121.742	16.628
1700	13.700	90.058	79.350	18.203	-129.353	-121.281	15.591
1800	13.722	90.841	79.967	19.575	-129.785	-120.794	14.666
1900	13.741	91.584	80.559	20.948	-130.221	-120.283	13.835
2000	13.757	92.289	81.128	22.323	-130.661	-119.746	13.085
2100	13.771	92.961	81.675	23.699	-131.106	-119.190	12.404
2200	13.784	93.602	82.203	25.077	-131.554	-118.610	11.782
2300	13.794	94.214	82.712	26.456	-132.006	-118.014	11.213
2400	13.804	94.802	83.204	27.836	-132.463	-117.396	10.690
2500	13.812	95.365	83.679	29.217	-132.925	-116.760	10.207
2600	13.819	95.907	84.139	30.598	-133.391	-116.103	9.759
2700	13.826	96.429	84.584	31.980	-133.862	-115.429	9.343
2800	13.832	96.932	85.016	33.363	-134.336	-114.735	8.955
2900	13.837	97.417	85.436	34.747	-134.815	-114.030	8.593
3000	13.842	97.887	85.843	36.131	-135.298	-113.304	8.254
3100	13.846	98.340	86.239	37.515	-135.784	-112.561	7.935
3200	13.850	98.780	86.624	38.900	-136.275	-111.806	7.636
3300	13.854	99.206	86.999	40.285	-136.773	-111.034	7.355
3400	13.857	99.620	87.364	41.671	-137.272	-110.244	7.086
3500	13.860	100.027	87.720	43.057	-137.775	-109.440	6.833
3600	13.863	100.412	88.067	44.443	-138.282	-108.623	6.594
3700	13.865	100.792	88.406	45.829	-138.792	-107.794	6.367
3800	13.868	101.162	88.737	47.216	-139.305	-106.949	6.151
3900	13.870	101.522	89.060	48.603	-139.822	-106.088	5.945
4000	13.872	101.873	89.376	49.990	-140.342	-105.216	5.748
4100	13.874	102.216	89.685	51.377	-140.866	-104.335	5.561
4123.61	13.874	102.246	89.757	51.705	-140.990	-104.122	5.518
4123.63	13.874	102.246	89.757	51.705	-147.891	-104.126	5.518
4200	13.876	102.550	89.987	52.764	-148.413	-103.452	5.279
4300	13.877	102.877	90.284	54.152	-149.033	-102.794	4.978
4400	13.879	103.196	90.571	55.540	-149.654	-102.124	4.690
4500	13.880	103.508	90.857	56.928	-150.281	-101.444	4.414
4600	13.881	103.813	91.135	58.316	-150.909	-100.755	4.149
4700	13.883	104.111	91.408	59.704	-151.542	-100.056	3.895
4800	13.884	104.404	91.676	61.092	-152.179	-99.348	3.651
4900	13.885	104.690	91.939	62.481	-152.822	-98.631	3.416
5000	13.886	104.970	92.197	63.869	-153.471	-97.906	3.190
5100	13.887	105.245	92.450	65.258	-154.125	-97.171	2.972
5200	13.888	105.515	92.698	66.647	-154.785	-96.426	2.761
5300	13.889	105.780	92.943	68.036	-155.450	-95.671	2.559
5400	13.889	106.039	93.183	69.424	-156.121	-94.906	2.363
5500	13.890	106.294	93.419	70.813	-156.797	-94.131	2.174
5600	13.891	106.544	93.651	72.202	-157.478	-93.346	1.990
5700	13.892	106.790	93.879	73.592	-158.164	-92.551	1.813
5800	13.892	107.032	94.104	74.981	-158.856	-91.746	1.641
5900	13.893	107.269	94.325	76.370	-159.553	-90.931	1.474
6000	13.893	107.503	94.543	77.759	-160.256	-90.106	1.313

15 June 1963

MRP

URANIUM DIOXIDE (UO₂) (IDEAL MOLECULAR GAS) gfw = 270.07

$$\Delta H_{f0}^{\circ} = -116.0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -117 \pm 10.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.629 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 68.2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

Vibration Levels

$\omega \text{ (cm}^{-1}\text{)}$	$\omega \text{ (cm}^{-1}\text{)}$
900	925
400	

Bond lengths and angles:

$$\text{O} - \text{U distance} = 1.96 \text{ \AA}$$

$$\text{O} - \text{U} - \text{O angle} = 107 \text{ deg}$$

Heat of Formation

Computed see volume 1, this study (section IVB32.4.2).

Heat Capacity and Entropy

Computed using the polyatomic gas program and the above estimated constants.

References

See volume 1, this study (section IVB32.4.2).

TABLE 206

VANADIUM DIOXIDE

IDEAL MOLECULAR GAS

O₂V

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid V from 0° to 2190°K,
Liquid V from 2190° to 3648°K, Gaseous V from 3648° to 6000°K; Gaseous O₂; Gaseous VO₂.

T, °K	ΔG_p°	ΔH_f° cal/°K gfw $(H_T^\circ - H_{298}^\circ)/T$	ΔH_f° Kcal/gfw $(H_T^\circ - H_{298}^\circ)$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-2.785	-55.464	INFINITE
298.15	12.266	59.912	59.912	0.000	-55.876	41.836
300	12.290	59.988	59.913	0.023	-55.877	41.584
400	13.260	63.671	60.408	1.305	-55.902	31.404
500	13.793	66.693	61.372	2.660	-55.894	25.296
600	14.104	69.237	62.476	4.056	-55.893	21.224
700	14.299	71.427	63.602	5.477	-55.911	18.316
800	14.429	73.346	64.703	6.914	-55.959	16.133
900	14.521	75.051	65.760	8.362	-56.037	14.434
1000	14.588	76.584	66.767	9.817	-56.147	13.072
1100	14.639	77.977	67.723	11.279	-56.287	11.955
1200	14.678	79.253	68.632	12.745	-56.457	11.022
1300	14.709	80.429	69.495	14.214	-56.659	10.230
1400	14.735	81.520	70.315	15.687	-56.890	9.548
1500	14.755	82.537	71.096	17.161	-57.151	8.955
1600	14.777	83.490	71.841	18.637	-57.442	8.433
1700	14.786	84.386	72.553	20.115	-57.764	7.970
1800	14.798	85.231	73.234	21.595	-58.115	7.556
1900	14.809	86.032	73.887	23.075	-58.497	7.184
2000	14.818	86.792	74.513	24.556	-58.909	6.846
2100	14.825	87.515	75.115	26.038	-59.353	6.539
2190	14.831	88.137	75.638	27.373	-59.777	6.284
2190	14.831	88.137	75.638	27.373	-63.977	6.284
2200	14.832	88.205	75.695	27.521	-64.015	6.255
2300	14.838	88.864	76.253	29.005	-64.397	5.978
2400	14.843	89.496	76.792	30.489	-64.785	5.722
2500	14.848	90.102	77.312	31.973	-65.179	5.485
2600	14.852	90.684	77.815	33.458	-65.576	5.265
2700	14.856	91.245	78.302	34.944	-65.978	5.061
2800	14.859	91.785	78.774	36.430	-66.384	4.869
2900	14.862	92.306	79.232	37.916	-66.796	4.690
3000	14.865	92.810	79.676	39.402	-67.212	4.522
3100	14.867	93.298	80.108	40.889	-67.632	4.363
3200	14.869	93.770	80.528	42.375	-68.058	4.214
3300	14.871	94.227	80.936	43.862	-68.486	4.073
3400	14.873	94.671	81.333	45.350	-68.918	3.939
3500	14.875	95.103	81.721	46.837	-69.355	3.812
3600	14.876	95.522	82.098	48.325	-69.795	3.691
3647.68	14.877	95.717	82.275	49.034	-70.006	3.636
3647.68	14.877	95.717	82.275	49.034	-179.880	3.636
3700	14.878	95.929	82.466	49.812	-179.977	3.483
3800	14.879	96.326	82.826	51.300	-180.175	3.203
3900	14.880	96.713	83.177	52.788	-180.389	2.937
4000	14.882	97.089	83.520	54.276	-180.618	2.684
4100	14.883	97.457	83.856	55.764	-180.863	2.444
4200	14.884	97.815	84.184	57.253	-181.124	2.214
4300	14.885	98.166	84.505	58.741	-181.401	1.994
4400	14.886	98.508	84.819	60.230	-181.695	1.785
4500	14.886	98.842	85.127	61.718	-182.005	1.584
4600	14.887	99.170	85.429	63.207	-182.332	1.391
4700	14.888	99.490	85.725	64.696	-182.676	1.207
4800	14.888	99.803	86.015	66.185	-183.038	1.030
4900	14.889	100.110	86.299	67.673	-183.419	0.859
5000	14.890	100.411	86.579	69.162	-183.819	0.696
5100	14.890	100.706	86.853	70.651	-184.239	0.538
5200	14.891	100.995	87.122	72.140	-184.680	0.386
5300	14.891	101.279	87.386	73.629	-185.145	0.239
5400	14.892	101.557	87.646	75.119	-185.635	0.098
5500	14.892	101.830	87.902	76.608	-186.153	-0.039
5600	14.893	102.099	88.153	78.097	-186.703	-0.172
5700	14.893	102.362	88.400	79.586	-187.288	-0.300
5800	14.893	102.621	88.643	81.076	-187.913	-0.424
5900	14.894	102.876	88.882	82.565	-188.585	-0.545
6000	14.894	103.126	89.117	84.054	-189.309	-0.662

15 September 1963

HLS

VANADIUM DIOXIDE (VO₂) (IDEAL MOLECULAR GAS) gfw = 82.95

$$\Delta H_f^\circ = -55.464 \text{ kcal gfw}^{-1}$$

$$\Delta H_f^\circ_{298.15} = -55.876 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$S^\circ_{298.15} = 59.912 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H^\circ_{298.15} - H^\circ_0 = 2.785 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

ω , cm ⁻¹	ω , cm ⁻¹
883.1 (1)	1126.8 (1)
293.8 (2)	

Bond lengths and angles:

$$\text{V-O distance} = 1.59 \text{ \AA}$$

$$\text{O-V-O angle} = 180^\circ$$

Moment of inertia:

$$I = 13.4312 \times 10^{-39} \text{ gm cm}^2$$

$$\sigma = 2$$

$$B_e = 0.20838 \text{ cm}^{-1}$$

Heat of Formation

Based on Brewer and Rosenblatt¹ analysis of data by Berkowitz et al.²

Heat Capacity and Entropy

Estimated data were used to calculate thermodynamic functions.

References

1. Brewer, L. and G. Rosenblatt, Chem Rev. 61, 257 (1961).
2. Berkowitz, J. et al., J. Chem. Phys. 27, 87 (1957).

VANADIUM DIOXIDE (VO₂)

(IDEAL MOLECULAR GAS)

GFW = 82.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	C_T	$-(F_T - H_{298})/T$	$H_T - H_{298}$	ΔH_f	ΔF_f	Log K _p
298.15	±1.000	±3.000	±3.000	±0.000	±10.000		
1000	±1.000	±4.210	±3.508	±0.702			
2000	±1.000	±4.903	±4.052	±1.702			
3000	±1.000	±5.309	±4.408	±2.702			
4000	±1.000	±5.596	±4.671	±3.702			
5000	±1.000	±5.820	±4.879	±4.702			
6000	±1.000	±6.002	±5.052	±5.702			

TABLE 207

TUNGSTEN DIOXIDE

CONDENSED PHASE

O₂W

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid W from 0° to 3650°K,
 Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K,
 Gaseous O₂: Solid WO₂

T, °K	cal/°K gfw			Kcal/gfw			Log K_p
	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	
0	0.000	0.000	INFINITE	-2.077	-139.747	-139.747	INFINITE
298.15	13.320	12.080	12.080	0.000	-140.940	-127.596	93.526
300	13.350	12.162	12.080	0.025	-140.939	-127.513	92.889
400	15.172	16.266	12.618	1.459	-140.803	-123.041	67.223
500	16.160	19.767	13.707	3.030	-140.564	-118.636	51.853
600	16.860	22.827	14.994	4.700	-140.257	-114.277	41.623
700	17.425	25.493	16.293	6.440	-139.908	-109.977	34.335
800	17.916	27.884	17.596	8.230	-139.538	-105.713	28.878
900	18.366	30.026	18.859	10.050	-139.160	-101.524	24.652
1000	18.790	31.975	20.075	11.900	-138.770	-97.342	21.273
1100	19.197	33.767	21.240	13.780	-138.369	-93.242	18.524
1200	19.592	35.419	22.352	15.680	-137.963	-89.130	16.232
1300	19.978	36.965	23.419	17.610	-137.549	-85.107	14.307
1400	20.359	38.417	24.438	19.570	-137.126	-81.091	12.658
1500	20.736	39.804	25.417	21.580	-136.673	-77.103	11.233
1600	21.109	41.147	26.359	23.660	-136.173	-73.150	9.991
1700	21.479	42.468	27.268	25.840	-135.593	-69.231	8.900
1800	21.847	43.771	28.149	28.120	-134.935	-65.345	7.934
1900	22.214	45.058	29.005	30.500	-134.196	-61.499	7.074
2000	22.580	46.330	29.840	32.980	-133.379	-57.692	6.304

May 1962

CHW

TUNGSTEN DIOXIDE (WO₂) (CONDENSED PHASE)

gfw = 215.86

$$\Delta H_{f298.15}^{\circ} = -139.747 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 12.080 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.693 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 15.49 + 3.58 \times 10^{-3} T - 2.80 \times 10^{-5} T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$400^{\circ} \text{K} \leq T \leq 1800^{\circ} \text{K}$$

Structure

WO₂ remains solid until disproportionation occurs.

Heat of Formation

Based on data by Mah. ¹

Heat Capacity and Entropy

Low temperature data by King et al. ² High temperature data from same workers.

Melting and Vaporization

WO₂ does not melt, but rather disproportionates.

Further details in report by Barriault et al. ³

References

1. Mah, A. D., J. Am. Chem. Soc. 81 1582 (1959).
2. King, E. G., et al., U. S. Bur. Mines. Rept. 5664 (1960).
3. Barriault, R., et al., ASD-TR-61-260 May (1962), Pt. 1.

TABLE 208

TUNGSTEN DIOXIDE

IDEAL MOLECULAR GAS

O₂W

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid W from 0° to 3650°K,
 Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K;
 Gaseous O₂; Gaseous WO₂.

T, °K	C _p cal/°K gfw	S _T cal/°K gfw	-(F _T - H ₂₉₈)/T	H _T - H ₂₉₈ Kcal/gfw	ΔH_f°	ΔF_f°	Log K _p
0	0.000	0.000	INFINITE	-2.693	14.477	14.477	INFINITE
298.15	10.814	65.893	65.893	0.000	13.900	11.200	-8.209
300	10.835	65.960	65.893	0.020	13.896	11.183	-8.146
400	11.767	69.213	66.330	1.153	13.731	10.314	-5.635
500	12.370	71.908	67.184	2.362	13.608	9.466	-4.019
600	12.767	74.201	68.167	3.620	13.503	8.659	-3.154
700	13.035	76.190	69.174	4.911	13.403	7.846	-2.450
800	13.222	77.944	70.163	6.224	13.296	7.074	-1.932
900	13.356	79.509	71.116	7.554	13.184	6.285	-1.526
1000	13.455	80.922	72.027	8.894	13.064	5.546	-1.212
1100	13.530	82.208	72.895	10.244	12.935	4.777	-0.949
1200	13.588	83.388	73.721	11.600	12.797	4.067	-0.741
1300	13.634	84.477	74.507	12.961	12.642	3.318	-0.558
1400	13.671	85.489	75.256	14.326	12.470	2.605	-0.407
1500	13.701	86.433	75.970	15.695	12.282	1.908	-0.278
1600	13.726	87.318	76.652	17.066	12.073	1.222	-0.167
1700	13.747	88.151	77.304	18.440	11.847	0.551	-0.071
1800	13.764	88.937	77.929	19.816	11.601	-0.108	0.013
1900	13.779	89.682	78.528	21.193	11.337	-0.751	0.086
2000	13.792	90.389	79.103	22.571	11.052	-1.378	0.151
2100	13.803	91.062	79.657	23.951	10.749	-1.991	0.207
2200	13.812	91.704	80.190	25.332	10.426	-2.592	0.257
2300	13.820	92.319	80.704	26.713	10.084	-3.176	0.302
2400	13.828	92.907	81.200	28.096	9.722	-3.744	0.341
2500	13.834	93.472	81.680	27.479	9.340	-4.298	0.376
2600	13.840	94.014	82.144	30.863	8.939	-4.836	0.406
2700	13.845	94.537	82.593	32.247	8.518	-5.357	0.434
2800	13.850	95.040	83.029	33.637	8.078	-5.863	0.458
2900	13.854	95.526	83.452	35.017	7.618	-6.354	0.479
3000	13.857	95.996	83.862	36.402	7.138	-6.828	0.497
3100	13.861	96.450	84.261	37.788	6.640	-7.282	0.513
3200	13.864	96.891	84.649	39.175	6.122	-7.725	0.528
3300	13.867	97.317	85.029	40.561	5.586	-8.158	0.540
3400	13.869	97.731	85.394	41.948	5.030	-8.558	0.550
3500	13.871	98.133	85.752	43.335	4.456	-8.946	0.559
3600	13.874	98.524	86.101	44.722	3.862	-9.317	0.566
3650	13.875	98.714	86.272	45.416	3.512	-9.497	0.569
3650	13.875	98.714	86.272	45.416	-4.816	-9.497	0.569
3700	13.876	98.904	86.442	46.110	-5.131	-9.561	0.565
3800	13.877	99.274	86.775	47.497	-5.730	-9.671	0.556
3900	13.879	99.635	87.100	48.885	-6.331	-9.770	0.547
4000	13.881	99.986	87.418	50.273	-6.935	-9.844	0.538
4100	13.882	100.329	87.729	51.661	-7.543	-9.918	0.529
4200	13.883	100.664	88.033	53.049	-8.155	-9.962	0.518
4300	13.885	100.990	88.330	54.438	-8.769	-9.989	0.508
4400	13.886	101.305	88.622	55.826	-9.389	-10.014	0.497
4500	13.887	101.622	88.907	57.215	-10.011	-10.026	0.487
4600	13.888	101.927	89.187	58.604	-10.638	-10.014	0.476
4700	13.889	102.225	89.461	59.993	-11.270	-9.992	0.465
4800	13.890	102.518	89.732	61.382	-11.908	-9.955	0.453
4900	13.891	102.804	89.994	62.771	-12.552	-9.908	0.442
5000	13.891	103.085	90.254	64.160	-13.204	-9.845	0.430
5100	13.892	103.360	90.507	65.549	-13.865	-9.772	0.419
5200	13.894	103.630	90.757	66.938	-14.536	-9.682	0.407
5300	13.894	103.894	91.002	68.327	-15.220	-9.577	0.395
5400	13.894	104.154	91.244	69.717	-15.918	-9.466	0.383
5500	13.895	104.409	91.481	71.106	-16.634	-9.339	0.371
5600	13.895	104.659	91.714	72.496	-17.371	-9.201	0.359
5700	13.896	104.905	91.943	73.885	-18.134	-9.040	0.347
5800	13.896	105.147	92.169	75.275	-18.928	-8.874	0.334
5891	13.897	105.364	92.371	76.540	-19.684	-8.701	0.323
5891	13.897	105.364	92.371	76.540	-211.949	-8.701	0.323
5900	13.897	105.385	92.391	76.665	-212.021	-8.596	0.311
6000	13.897	105.618	92.609	78.054	-212.869	-8.926	0.179

May 1962

CHW

TUNGSTEN DIOXIDE (WO₂) (IDEAL MOLECULAR GAS) gfw = 215.86

$$\Delta H_{f0}^{\circ} = 14.477 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 13.900 \text{ Kcal gfw}^{-1}$$

Point Group C_{2v}

$$S_{298.15}^{\circ} = 65.893 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.693 \text{ Kcal gfw}^{-1}$$

Vibrational levels and multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
794 (1)	812 (1)
351 (1)	

Bond lengths and angles:

W - O distance = 1.78 Å

O - W - O Angle = 107 deg

Product of moments of inertia: $I_A I_B I_C = 8.80082 \times 10^{-115} \text{ g}^3 \text{ cm}^6$ $\sigma = 2$

Heat of Formation

Based on work of DeMaria et al.¹

Heat Capacity and Entropy

Calculated using spectroscopic constants. See Barriault et al.² for further details.

References

1. DeMaria, G., et al., J. Chem. Phys. 32 1373 (1960).
2. Barriault, R. et al., ASD-TR-61-260 May (1962), Pt. 1.

ZIRCONIUM DIOXIDE

TABLE 209
CONDENSED PHASEO₂Zr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$. Solid Zr from 0° to 2125°K,
Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K; Gaseous O₂;
Monoclinic ZrO₂ from 0° to 1478°K, Tetragonal ZrO₂ from 1478° to 2973°K,
Liquid ZrO₂ from 2973° to 6000°K.

T, °K	ϵ_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-2.091	-260.203	-260.203	INFINITE
298.15	13.397	12.120	12.120	0.000	-261.500	-247.732	181.584
300	13.447	12.203	12.120	0.025	-261.499	-247.647	180.402
400	15.260	16.353	12.674	1.472	-261.393	-243.042	132.786
500	16.196	19.868	13.771	3.049	-261.220	-238.474	104.232
600	16.787	22.877	15.044	4.700	-261.026	-233.942	85.209
700	17.214	25.498	16.354	6.401	-260.825	-229.444	71.632
800	17.555	27.820	17.645	8.140	-260.626	-224.975	61.457
900	17.845	29.905	18.893	9.910	-260.429	-220.530	53.549
1000	18.104	31.798	20.091	11.708	-260.235	-216.107	47.228
1100	18.342	33.535	21.235	13.530	-260.044	-211.704	42.060
1135	18.422	34.111	21.623	14.174	-259.976	-210.166	40.467
1135	18.422	34.111	21.623	14.174	-260.891	-210.166	40.467
1200	18.567	35.141	22.328	15.376	-260.755	-207.266	37.746
1300	18.781	36.636	23.372	17.243	-260.535	-202.818	34.095
1400	18.989	38.035	24.369	19.132	-260.300	-198.387	30.968
1478	19.147	39.069	25.118	20.619	-260.107	-194.941	28.824
1478	17.800	40.030	25.118	22.039	-258.687	-194.941	28.824
1500	17.800	40.293	25.339	22.431	-258.661	-193.994	28.264
1600	17.800	41.441	26.310	24.211	-258.548	-189.687	25.909
1700	17.800	42.521	27.232	25.991	-258.441	-185.386	23.832
1800	17.800	43.538	28.110	27.771	-258.340	-181.092	21.987
1900	17.800	44.500	28.947	29.551	-258.244	-176.802	20.336
2000	17.800	45.413	29.748	31.331	-258.154	-172.518	18.851
2000	17.800	45.413	29.748	31.331	-258.154	-172.518	18.851
2100	18.437	46.297	30.515	33.143	-258.038	-168.239	17.508
2125	18.596	46.516	30.702	33.605	-258.000	-167.169	17.192
2125	18.596	46.516	30.702	33.605	-262.900	-167.169	17.192
2200	19.074	47.170	31.252	35.018	-262.771	-163.791	16.270
2300	19.712	48.032	31.963	36.957	-262.548	-159.300	15.136
2400	20.349	48.884	32.650	38.960	-262.267	-154.815	14.097
2500	20.986	49.728	33.317	41.027	-261.928	-150.348	13.143
2600	21.623	50.563	33.964	43.158	-261.529	-145.888	12.262
2700	22.260	51.391	34.594	45.352	-261.073	-141.453	11.449
2800	22.898	52.212	35.209	47.610	-260.557	-137.032	10.695
2900	23.535	53.027	35.809	49.931	-259.984	-132.627	9.995
2973	24.000	53.618	36.239	51.666	-259.528	-129.427	9.514
2973	24.000	62.027	36.239	76.666	-234.528	-129.427	9.514
3000	24.000	62.244	36.472	77.314	-234.353	-128.474	9.359
3100	24.000	63.031	37.316	79.714	-233.710	-124.951	8.809
3200	24.000	63.793	38.132	82.114	-233.072	-121.458	8.295
3300	24.000	64.531	38.921	84.514	-232.437	-117.980	7.813
3400	24.000	65.248	39.684	86.914	-231.807	-114.518	7.361
3500	24.000	65.943	40.425	89.314	-231.181	-111.077	6.936
3600	24.000	66.619	41.143	91.714	-230.559	-107.654	6.535
3700	24.000	67.277	41.841	94.114	-229.940	-104.250	6.157
3800	24.000	67.917	42.518	96.514	-229.325	-100.859	5.800
3900	24.000	68.540	43.178	98.914	-228.714	-97.486	5.463
4000	24.000	69.148	43.819	101.314	-228.106	-94.124	5.142
4100	24.000	69.741	44.444	103.714	-227.502	-90.784	4.839
4200	24.000	70.319	45.054	106.114	-226.902	-87.460	4.551
4300	24.000	70.884	45.648	108.514	-226.305	-84.142	4.276
4400	24.000	71.435	46.228	110.914	-225.713	-80.845	4.015
4500	24.000	71.975	46.794	113.314	-225.124	-77.558	3.767
4600	24.000	72.502	47.347	115.714	-224.540	-74.280	3.529
4644.05	24.000	72.731	47.58	116.772	-224.283	-72.840	3.428
4644.05	24.000	72.731	47.587	116.772	-359.737	-72.840	3.428
4700	24.000	73.018	47.888	118.114	-359.469	-69.388	3.226
4800	24.000	73.524	48.417	120.514	-358.997	-63.222	2.878
4900	24.000	74.019	48.934	122.914	-358.537	-57.057	2.545
5000	24.000	74.503	49.441	125.314	-358.089	-50.910	2.225
5100	24.000	74.979	49.937	127.714	-357.655	-44.776	1.919
5200	24.000	75.445	50.423	130.114	-357.236	-38.638	1.624
5300	24.000	75.902	50.899	132.514	-356.834	-32.514	1.341
5400	24.000	76.350	51.366	134.914	-356.450	-26.395	1.068
5500	24.000	76.791	51.825	137.314	-356.086	-20.287	0.806
5600	24.000	77.223	52.274	139.714	-355.748	-14.176	0.553
5700	24.000	77.648	52.716	142.114	-355.438	-8.078	0.310
5800	24.000	78.065	53.149	144.514	-355.161	-1.979	0.075
5900	24.000	78.476	53.575	146.914	-354.924	4.112	-0.152
6000	24.000	78.879	53.993	149.314	-354.733	10.210	-0.372

15 September 1963

HLS

ZIRCONIUM DIOXIDE (ZrO₂)

(CONDENSED PHASE)

gfw = 123.22

$$\Delta H_{f298.15}^{\circ} = -261.5 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 12.12 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_t = 1478^{\circ}\text{K}$$

$$\Delta H_t = 1.42 \text{ kcal gfw}^{-1}$$

$$T_m = 2973^{\circ}\text{K}$$

$$\Delta H_m = 25.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.091 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 16.64 + 1.80 \times 10^{-3}T - 3.36 \times 10^{-5}T^{-2} \text{ cal deg}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 1478^{\circ}\text{K}$$

$$C_p^{\circ} = 17.80 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1478^{\circ}\text{K} \leq T \leq 2000^{\circ}\text{K}$$

$$C_p^{\circ} = 5.056 + .006372T \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2000^{\circ}\text{K} \leq T \leq 2973^{\circ}\text{K}$$

$$C_p^{\circ} = 24.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2973^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

ZrO₂ exists as monoclinic form below 1478°K and tetragonal above.Heat of FormationCombustion calorimetry was used by Humphrey.¹Heat Capacity and EntropyLow temperature data from Kelley² and Kelley and King.³ High temperature data to 2000°K from Kelley.⁴ Data above 2000°K estimated.Melting and Vaporization

Heat of melting was estimated.

References

1. Humphrey, G. L., J. Am. Chem. Soc. 76, 978 (1954).
2. Kelley, K. K., Ind. Eng. Chem. 36, 377 (1944).
3. Kelley, K. K., and E. G. King, Bur. of Mines. Bull. 592 (1961).
4. Kelley, K. K., Bur. of Mines Bull. 584 (1960).

ZIRCONIUM DIOXIDE (ZrO₂)

(CONDENSED PHASE)

GFW = 123.22

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.300	±0.080	±0.080	±0.000	±2.000		
1000	±0.300	±0.443	±0.232	±0.211			
1478	±0.300	±0.560	±0.321	±0.354			
1478	±2.000	±0.560	±0.321	±0.354			
2000	±2.000	±1.165	±0.466	±1.398			
2973	±2.000	±1.958	±0.833	±3.344			
2973	±2.000	±4.649	±0.833	±11.344			
3000	±2.000	±4.667	±0.868	±11.398			
4000	±2.000	±5.242	±1.893	±13.398			
5000	±2.000	±5.689	±2.609	±15.398			
6000	±2.000	±6.053	±3.154	±17.398			

TABLE 210

ZIRCONIUM DIOXIDE

IDEAL MOLECULAR GAS

O₂Zr

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Zr from 0° to 2125°K,
Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K; Gaseous O₂; Gaseous ZrO₂.

T, °K	C_p	$\frac{cal}{^\circ K \text{ gfw}}$ $\frac{1}{T}$	$\frac{1}{(F - H_{298})/T}$	$\frac{Kcal}{gfw}$ $H_T - H_{298}$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-2.725	-81.794	-81.794	INFINITE
298.15	11.365	58.551	58.551	0.000	-82.457	-82.533	60.495
300	11.385	58.621	58.551	0.021	-82.460	-82.533	60.123
400	12.329	62.033	59.010	1.209	-82.613	-82.534	45.092
500	12.998	64.860	59.905	2.478	-82.748	-82.498	36.058
600	13.461	67.274	60.937	3.802	-82.881	-82.435	30.025
700	13.784	69.374	61.996	5.165	-83.018	-82.351	25.710
800	14.014	71.231	63.031	6.556	-83.167	-82.245	22.467
900	14.182	72.892	64.041	7.966	-83.330	-82.120	19.941
1000	14.308	74.393	65.002	9.391	-83.509	-81.975	17.915
1100	14.405	75.761	65.919	10.827	-83.704	-81.813	16.254
1135	14.433	76.213	66.229	11.331	-83.776	-81.751	15.741
1135	14.433	76.213	66.229	11.331	-84.691	-81.751	15.741
1200	14.480	77.018	66.792	12.271	-84.817	-81.580	14.857
1300	14.540	78.179	67.624	13.722	-85.013	-81.303	13.668
1400	14.588	79.259	68.417	15.179	-85.210	-81.011	12.646
1500	14.627	80.267	69.174	16.639	-85.411	-80.703	11.758
1600	14.660	81.212	69.897	18.104	-85.612	-80.383	10.979
1700	14.687	82.101	70.589	19.571	-85.818	-80.050	10.291
1800	14.710	82.941	71.252	21.041	-86.027	-79.705	9.677
1900	14.729	83.737	71.888	22.513	-86.239	-79.347	9.127
2000	14.746	84.493	72.500	23.987	-86.455	-78.979	8.630
2100	14.760	85.213	73.088	25.462	-86.676	-78.599	8.180
2125	14.764	85.388	73.232	25.831	-86.731	-78.502	8.073
2125	14.764	85.388	73.232	25.831	-91.631	-78.502	8.073
2200	14.773	85.900	73.655	26.939	-91.807	-78.035	7.752
2300	14.784	86.557	74.202	28.417	-92.045	-77.406	7.355
2400	14.794	87.186	74.730	29.895	-92.289	-76.764	6.990
2500	14.802	87.790	75.240	31.375	-92.537	-76.112	6.653
2600	14.810	88.371	75.734	32.856	-92.788	-75.447	6.342
2700	14.817	88.930	76.213	34.337	-93.045	-74.781	6.053
2800	14.823	89.469	76.677	35.819	-93.305	-74.099	5.783
2900	14.828	89.984	77.127	37.302	-93.570	-73.406	5.532
3000	14.833	90.492	77.564	38.785	-93.839	-72.707	5.296
3100	14.838	90.979	77.989	40.268	-94.113	-71.994	5.075
3200	14.842	91.450	78.402	41.752	-94.391	-71.279	4.868
3300	14.845	91.906	78.804	43.237	-94.671	-70.551	4.672
3400	14.849	92.350	79.196	44.721	-94.957	-69.816	4.487
3500	14.852	92.780	79.578	46.206	-95.246	-69.069	4.313
3600	14.855	93.199	79.951	47.692	-95.531	-68.320	4.147
3700	14.857	93.606	80.314	49.177	-95.834	-67.557	3.990
3800	14.860	94.002	80.669	50.663	-96.133	-66.790	3.841
3900	14.862	94.388	81.016	52.149	-96.436	-66.011	3.699
4000	14.864	94.764	81.355	53.636	-96.741	-65.225	3.564
4100	14.866	95.131	81.687	55.122	-97.051	-64.437	3.435
4200	14.868	95.490	82.011	56.609	-97.364	-63.637	3.311
4300	14.870	95.839	82.329	58.096	-97.680	-62.827	3.193
4400	14.871	96.181	82.640	59.583	-98.001	-62.015	3.080
4500	14.873	96.515	82.944	61.070	-98.325	-61.190	2.972
4600	14.874	96.842	83.243	62.557	-98.654	-60.359	2.868
4644.05	14.875	96.984	83.373	63.212	-98.800	-59.789	2.823
4644.05	14.875	96.984	83.373	63.212	-234.254	-59.789	2.823
4700	14.875	97.162	83.536	64.745	-234.495	-57.890	2.692
4800	14.876	97.475	83.823	65.532	-234.936	-54.127	2.464
4900	14.878	97.782	84.105	67.020	-235.388	-50.352	2.246
5000	14.879	98.083	84.381	68.508	-235.852	-46.567	2.035
5100	14.880	98.377	84.653	69.996	-236.330	-42.784	1.833
5200	14.881	98.666	84.920	71.484	-236.823	-38.980	1.638
5300	14.881	98.950	85.182	72.972	-237.333	-35.170	1.450
5400	14.882	99.228	85.439	74.460	-237.861	-31.346	1.269
5500	14.883	99.501	85.692	75.948	-238.409	-27.512	1.093
5600	14.884	99.769	85.941	77.437	-238.982	-23.668	0.924
5700	14.885	100.033	86.186	78.925	-239.584	-19.814	0.760
5800	14.885	100.292	86.427	80.413	-240.219	-15.948	0.601
5900	14.886	100.546	86.664	81.902	-240.893	-12.070	0.447
6000	14.886	100.796	86.898	83.391	-241.613	-8.177	0.298

15 September 1963

HLS

ZIRCONIUM DIOXIDE (ZrO₂)

(IDEAL MOLECULAR GAS)

gfw = 123.22

$$\Delta H_f^\circ = -81.794 \text{ kcal gfw}^{-1}$$

$$\Delta H_f^\circ(298.15) = -82.457 \text{ kcal gfw}^{-1}$$

Point Group D_{∞h}

$$H^\circ(298.15) - H^\circ(0) = 2.725 \text{ kcal gfw}^{-1}$$

$$S^\circ(298.15) = 58.551 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Vibrational Levels and Multiplicities $\omega, \text{ cm}^{-1}$ $\omega, \text{ cm}^{-1}$

863.8 (1)

1003.9 (1)

261.8 (2)

Bond lengths and angles:

Zr-O distance = 1.728 Å

O-Zr-O Angle = 180°

Moments of inertia:

$$I = 15.8638 \times 10^{-39} \text{ gcm}^2$$

$$\sigma = 2$$

Heat of FormationData of Chupka, et al¹ was analyzed by third law method.Heat Capacity and Entropy

Above basic input data was used.

Reference

1. Chupka, W. J., J. Berkowitz, M. Inghram, J. Chem. Phys. 26, 1207 (1957).

ZIRCONIUM DIOXIDE (ZrO₂)

(IDEAL MOLECULAR GAS)

GFW = 123.22

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔG _f ^o	
298.15	±1.000	±3.000	±3.000	±0.000	±7.000		
1000	±1.000	±4.210	±3.508	±0.702			
2000	±1.000	±4.903	±4.052	±1.702			
3000	±1.000	±5.309	±4.408	±2.702			
4000	±1.000	±5.596	±4.611	±3.702			
5000	±1.000	±5.820	±4.879	±4.702			
6000	±1.000	±6.002	±5.052	±5.702			

TABLE 211

OSMIUM TRIOXIDE

IDEAL MOLECULAR GAS

O₃O_s

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$ Solid Os from 0° to 3290°K
 Liquid Os from 3290° to 5270°K, Gaseous Os from 5270° to 6000°K;
 Gaseous O₂, Gaseous OsO₃.

T, °K	C_p cal/°K gfw	C_T cal/°K gfw	$(F_T^\circ - H_{298}^\circ)/T$ cal/°K gfw	$H_T^\circ - H_{298}^\circ$ Kcal/gfw	ΔH_f° Kcal/gfw	ΔF_f° Kcal/gfw	$\log K_p$
0	0.000	0.000	INFINITE	-3.331	-66.809	-66.809	INFINITE
298.15	14.994	69.201	69.201	0.000	-67.800	-64.190	47.050
300	15.029	69.294	69.201	0.028	-67.803	-64.167	46.743
400	16.535	73.839	69.811	1.611	-67.885	-62.940	34.387
500	17.494	77.640	71.007	3.317	-67.883	-61.703	26.969
600	18.115	80.888	72.390	5.099	-67.853	-60.469	22.025
700	18.529	83.714	73.810	6.933	-67.811	-59.247	18.495
800	18.817	86.208	75.277	8.801	-67.775	-58.020	15.850
900	19.023	88.437	76.555	10.693	-67.748	-56.802	13.793
1000	19.175	90.449	77.846	12.604	-67.731	-55.587	12.148
1100	19.291	92.283	79.076	14.527	-67.728	-54.372	10.802
1200	19.380	93.965	80.248	16.461	-67.736	-53.158	9.681
1300	19.450	95.519	81.363	18.403	-67.759	-51.943	8.732
1400	19.507	96.963	82.427	20.351	-67.795	-50.726	7.918
1500	19.553	98.310	83.441	22.304	-67.843	-49.504	7.212
1600	19.591	99.573	84.410	24.261	-67.907	-48.281	6.595
1700	19.622	100.762	85.338	26.222	-67.989	-47.052	6.049
1800	19.649	101.884	86.226	28.185	-68.078	-45.818	5.563
1900	19.671	102.947	87.078	30.151	-68.185	-44.577	5.127
2000	19.691	103.957	87.897	32.119	-68.307	-43.330	4.735
2100	19.707	104.918	88.685	34.089	-68.446	-42.078	4.379
2200	19.722	105.835	89.444	36.061	-68.599	-40.818	4.055
2300	19.735	106.712	90.176	38.033	-68.768	-39.555	3.758
2400	19.746	107.552	90.882	40.008	-68.952	-38.279	3.486
2500	19.756	108.355	91.565	41.983	-69.153	-37.001	3.234
2600	19.764	109.134	92.226	43.959	-69.368	-35.704	3.001
2700	19.772	109.880	92.867	45.935	-69.602	-34.410	2.785
2800	19.779	110.599	93.487	47.913	-69.848	-33.100	2.583
2900	19.785	111.293	94.089	49.891	-70.112	-31.783	2.395
3000	19.791	111.964	94.674	51.870	-70.389	-30.458	2.219
3100	19.796	112.613	95.242	53.849	-70.683	-29.117	2.053
3200	19.801	113.241	95.795	55.829	-70.992	-27.776	1.897
3290	19.805	113.790	96.279	57.612	-71.282	-26.555	1.764
3300	19.805	113.790	96.279	57.612	-71.282	-26.555	1.764
3400	19.809	114.442	96.857	59.390	-71.590	-25.395	1.648
3500	19.813	115.016	97.367	61.171	-71.900	-24.279	1.549
3600	19.816	115.575	97.865	62.953	-72.220	-23.187	1.448
3700	19.819	116.118	98.351	64.735	-72.550	-22.157	1.309
3800	19.822	116.646	98.826	66.517	-72.890	-21.194	1.178
3900	19.824	117.161	99.290	68.299	-73.240	-20.299	1.052
4000	19.827	117.663	99.743	70.081	-73.600	-19.463	0.933
4100	19.829	118.153	100.186	71.863	-73.970	-18.687	0.819
4200	19.831	118.630	100.619	73.645	-74.350	-17.970	0.710
4300	19.833	119.097	101.044	75.427	-74.740	-17.300	0.605
4400	19.835	119.553	101.459	77.209	-75.140	-16.670	0.505
4500	19.836	119.999	101.866	78.991	-75.550	-16.080	0.409
4600	19.838	120.434	102.265	80.773	-75.970	-15.530	0.317
4700	19.839	120.861	102.656	82.555	-76.400	-15.020	0.228
4800	19.841	121.279	103.040	84.337	-76.840	-14.540	0.143
4900	19.842	121.688	103.416	86.119	-77.290	-14.090	0.061
5000	19.843	122.089	103.786	87.901	-77.750	-13.670	0.019
5100	19.844	122.482	104.148	89.683	-78.220	-13.280	-0.095
5200	19.845	122.867	104.505	91.465	-78.700	-12.920	-0.169
5269.57	19.846	123.132	104.750	93.247	-79.190	-12.580	-0.241
5269.57	19.846	123.132	104.750	93.247	-79.190	-12.580	-0.289
5300	19.846	123.245	104.855	95.029	-79.690	-12.260	-0.352
5400	19.847	123.616	105.199	96.811	-80.200	-11.970	-0.424
5500	19.848	123.981	105.537	98.593	-80.720	-11.700	-0.496
5600	19.849	124.338	105.870	100.375	-81.250	-11.450	-0.568
5700	19.850	124.690	106.197	102.157	-81.790	-11.220	-0.640
5800	19.851	125.035	106.518	103.939	-82.340	-11.010	-0.712
5900	19.851	125.374	106.835	105.721	-82.900	-10.820	-0.784
6000	19.852	125.708	107.147	107.503	-83.470	-10.650	-0.856

15 September 1962

CHW

OSMIUM TRIOXIDE (OsO₃)

(IDEAL MOLECULAR GAS)

gfw = 238.2

$$\Delta H_{f0}^{\circ} = -66.809 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -67.800 \text{ kcal gfw}^{-1}$$

Point Group = D_{3h}

$$S_{298.15}^{\circ} = 69.201 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.331 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
764 (1)	811 (2)
291 (1)	292 (2)

Bond lengths and angles:

$$\text{Os-O distance} = 185 \text{ \AA}$$

$$\text{O-Os-O angle} = 120^{\circ}$$

Product of moments of inertia:

$$I_A I_B I_C = 5.072420 \times 10^{-114} \text{ g}^3 \text{ cm}^6 \quad \sigma = 6$$

Heat of Formation

Based on Grimley et al.¹ mass-spectrometric data.

Heat Capacity and Entropy

Spectroscopic data estimated. See volume 1, this study (section IVB18.4.3) for details.

Reference

1. Grimley, R. T., R. P. Burns, and M. G. Inghram, J. Chem. Phys. 33, 308 (1960).

TABLE 212

TITANIUM SESQUIOXIDE

CONDENSED PHASE

 O_3Ti_2

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
 Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K; Gaseous O_2 ;
 Solid Ti_2O_3 from 0° to 2093°K, Liquid Ti_2O_3 from 2093° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-3.435	-361.423	-361.423	INFINITE
298.15	23.267	18.830	18.830	0.000	-363.400	-342.726	251.213
300	23.366	18.974	18.830	0.043	-363.398	-342.598	249.570
400	28.718	26.429	19.811	2.647	-363.099	-335.698	183.408
473	32.675	31.562	21.231	4.886	-362.600	-330.757	152.819
500	30.736	32.016	21.231	5.101	-362.385	-330.757	152.819
600	31.250	33.737	21.860	5.938	-362.203	-328.934	143.770
600	32.627	39.566	24.337	9.138	-361.483	-322.348	117.409
700	33.508	44.666	26.884	12.447	-360.727	-315.885	98.619
800	34.126	49.183	29.395	15.831	-359.960	-309.532	84.556
900	34.591	53.231	31.822	19.268	-359.194	-303.272	73.641
1000	34.960	56.895	34.149	22.746	-358.438	-297.098	64.928
1100	35.267	60.242	36.371	26.258	-357.693	-291.002	57.814
1155	35.417	61.966	37.549	28.201	-357.287	-287.676	54.432
1155	35.417	61.966	37.549	28.201	-359.187	-287.676	54.432
1200	35.532	63.322	38.491	29.798	-358.857	-284.897	51.884
1300	35.766	66.176	40.512	33.363	-358.133	-278.765	46.862
1400	35.980	68.834	42.441	36.950	-357.422	-272.686	42.566
1500	36.177	71.323	44.284	40.558	-356.719	-266.658	38.850
1600	36.357	73.664	46.048	44.185	-356.030	-260.678	35.605
1700	36.517	75.874	47.738	47.830	-355.351	-254.738	32.747
1800	36.705	77.967	49.360	51.493	-354.684	-248.840	30.212
1900	36.867	79.956	50.918	55.171	-354.029	-242.975	27.947
1950	36.947	80.915	51.675	57.017	-353.704	-240.056	26.903
1950	36.947	80.915	51.675	57.017	-361.104	-240.056	26.903
2000	37.025	81.851	52.418	58.866	-360.734	-236.958	25.892
2093	37.168	83.537	53.764	62.776	-360.035	-231.220	24.143
2093	37.168	83.537	53.764	62.776	-360.035	-231.220	24.143
2100	37.500	98.348	53.764	93.316	-329.035	-231.220	24.143
2100	37.500	98.348	53.764	93.316	-328.981	-230.891	24.028
2200	37.500	100.218	55.978	97.328	-328.197	-226.240	22.474
2300	37.500	101.885	57.938	101.078	-327.421	-221.625	21.058
2400	37.500	103.481	59.803	104.828	-326.654	-217.040	19.763
2500	37.500	105.012	61.580	108.578	-325.896	-212.489	18.575
2600	37.500	106.483	63.279	112.328	-325.144	-207.963	17.480
2700	37.500	107.898	64.906	116.078	-324.401	-203.475	16.469
2800	37.500	109.262	66.466	119.799	-323.664	-199.006	15.532
2900	37.500	110.578	67.964	123.478	-322.936	-194.566	14.662
3000	37.500	111.849	69.406	127.128	-322.214	-190.154	13.852
3100	37.500	113.078	70.795	131.078	-321.500	-185.762	13.096
3200	37.500	114.269	72.135	134.828	-320.791	-181.398	12.388
3300	37.500	115.424	73.430	138.578	-320.090	-177.049	11.725
3400	37.500	116.542	74.681	142.328	-319.395	-172.723	11.102
3500	37.500	117.630	75.893	146.078	-318.706	-168.420	10.516
3550	37.500	118.161	76.484	147.953	-318.363	-166.276	10.236
3550	37.500	118.161	76.484	147.953	-523.277	-166.276	10.236
3600	37.500	118.686	77.067	149.828	-522.947	-161.251	9.789
3700	37.500	119.713	78.200	153.578	-522.309	-151.212	8.931
3800	37.500	120.713	79.311	157.328	-521.704	-141.186	8.120
3900	37.500	121.688	80.385	161.078	-521.134	-131.184	7.351
4000	37.500	122.637	81.430	164.828	-520.592	-121.190	6.621
4100	37.500	123.563	82.446	168.578	-520.082	-111.279	5.928
4200	37.500	124.467	83.436	172.328	-519.602	-101.370	5.268
4300	37.500	125.349	84.401	176.078	-519.150	-91.283	4.639
4400	37.500	126.211	85.341	179.828	-518.728	-81.334	4.040
4500	37.500	127.054	86.259	183.578	-518.333	-71.409	3.468
4600	37.500	127.878	87.154	187.328	-517.965	-61.465	2.920
4700	37.500	128.684	88.030	191.078	-517.626	-51.555	2.397
4800	37.500	129.474	88.885	194.828	-517.315	-41.634	1.896
4900	37.500	130.247	89.721	198.578	-517.030	-31.721	1.415
5000	37.500	131.005	90.549	202.328	-516.774	-21.820	0.954
5100	37.500	131.747	91.360	206.078	-516.549	-11.923	0.511
5200	37.500	132.474	92.154	209.828	-516.353	-2.031	0.085
5300	37.500	133.186	92.932	213.578	-516.190	7.868	-0.324
5400	37.500	133.881	93.695	217.328	-516.064	17.748	-0.718
5500	37.500	134.561	94.443	221.078	-515.976	27.647	-1.099
5600	37.500	135.225	95.177	224.828	-515.932	37.524	-1.464
5700	37.500	135.874	95.897	228.578	-515.936	47.422	-1.818
5800	37.500	136.511	96.604	232.328	-515.998	57.312	-2.159
5900	37.500	137.132	97.298	236.078	-516.124	67.211	-2.490
6000	37.500	137.742	97.977	239.828	-516.324	77.138	-2.809

31 December 1963

HLS

TITANIUM SESQUIOXIDE (Ti₂O₃) (CONDENSED PHASE) gfw = 143.80

$$\Delta H_{f298.15}^{\circ} = -363.4 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 18.83 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_f = 473^{\circ}\text{K}$$

$$\Delta H_f = 0.215 \text{ kcal gfw}^{-1}$$

$$T_m = 2093^{\circ}\text{K}$$

$$\Delta H_m = 31.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.435 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 7.31 + 53.52 \times 10^{-3} T \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 473^{\circ}\text{K}$$

$$C_p^{\circ} = 34.68 + 1.30 \times 10^{-3} T - 10.20 \times 10^{-5} T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$473^{\circ}\text{K} \leq T \leq 2093^{\circ}\text{K}$$

$$C_p^{\circ} = 37.5 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$2093^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

Ti₂O₃ has hexagonal structure with narrow homogeneity range according to Andersson et al.

Heat of Formation

Combustion calorimetric data of Mah et al.² used.

Heat Capacity and Entropy

Low-temperature data by Shomate.³ High-temperature data by Naylor⁴ to 1750°K extrapolated to melting point. Data at higher temperatures estimated.

Melting and Vaporization

Melting point from Brauer and Littke.⁵ Heat of fusion estimated.

References

1. Andersson, S. et al., Acta Chem. Scand. 11, 1653 (1957).
2. Mah, A. et al., U. S. Bur. Mines, Rept. 5316 (1957).
3. Shomate, C., J. Am. Chem. Soc. 68, 310 (1946).
4. Naylor, B., J. Am. Chem. Soc. 68, 1077 (1946).
5. Brauer, G. and W. Littke, J. Inorg. Nuclear Chem. 16, 67 (1960).

TITANIUM SESQUIOXIDE (Ti₂O₃)

(CONDENSED PHASE)

GFW = 143.80

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal. k gfw ⁻¹				k. J. gfw ⁻¹	
	C _p	S _T	-ΔH _T - H _{298.15}	H _T - H _{298.15}	ΔH _f	ΔH _m
298.15	± 0.400	± 0.090	± 0.090	± 0.000	11.500	
473	± 0.400	± 0.275	± 0.127	± 0.070		
473	± 1.000	± 0.380	± 0.127	± 0.120		
1000	± 1.000	± 1.129	± 0.467	± 0.647		
2000	± 1.000	± 1.822	± 0.999	± 1.647		
2093	± 1.000	± 1.868	± 1.036	± 1.740		
2093	± 5.000	± 5.690	± 1.036	± 9.740		
3000	± 5.000	± 7.490	± 2.732	± 18.275		
4000	± 5.000	± 8.928	± 4.110	± 19.275		
5000	± 5.000	± 10.044	± 5.189	± 24.275		
6000	± 5.000	± 10.956	± 6.076	± 29.275		

TABLE 213

TUNGSTEN TRIOXIDE

CONDENSED PHASE

O₃W

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid W; Gaseous O₂;
Solid WO₃ from 0° to 1745°K, Liquid WO₃ from 1745° to 2000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-2.962	-200.115	-200.115	INFINITE
298.15	17.600	18.150	18.150	0.000	-201.460	-182.620	133.858
300	17.650	18.259	18.150	0.033	-201.458	-182.503	132.947
400	19.849	23.663	18.870	1.917	-201.226	-176.205	96.269
500	21.182	28.249	20.299	3.975	-200.866	-169.999	74.303
600	22.060	32.193	21.961	6.139	-200.443	-163.852	59.680
700	22.724	35.645	23.674	8.380	-199.982	-157.803	49.266
800	23.273	38.716	25.366	10.680	-199.501	-151.797	41.467
900	23.756	41.486	27.005	13.033	-198.996	-145.130	35.241
1000	24.198	44.012	28.582	15.430	-198.473	-139.986	30.592
1050	24.408	45.197	29.344	16.646	-198.207	-137.085	28.532
1050	23.678	45.587	29.344	17.056	-197.797	-137.085	28.532
1100	23.815	46.691	30.106	18.243	-197.559	-134.200	26.662
1200	24.090	48.775	31.577	20.638	-197.082	-128.438	23.391
1300	24.365	50.714	32.975	23.061	-196.603	-122.764	20.638
1400	24.640	52.530	34.308	25.511	-196.122	-117.107	18.280
1500	24.915	54.239	35.580	27.989	-195.637	-111.479	16.242
1600	25.190	55.856	36.797	30.494	-195.150	-105.883	14.462
1700	25.465	57.391	37.963	33.027	-194.659	-100.320	12.896
1745	25.589	58.058	38.473	34.176	-194.440	-97.833	12.252
1745	31.500	68.115	38.473	51.726	-176.890	-97.833	12.252
1800	31.500	69.093	39.394	53.458	-176.294	-95.344	11.576
1900	31.500	70.745	41.001	56.608	-175.232	-90.871	10.452
2000	31.500	72.411	42.532	59.758	-174.195	-86.458	9.447

May 1962

CHW

$$\Delta H_{f298.15}^{\circ} = -201.460 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 18.15 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_t = 1050^{\circ}\text{K}$$

$$\Delta H_t = 0.410 \text{ Kcal gfw}^{-1}$$

$$T_m = 1745^{\circ}\text{K}$$

$$\Delta H_m = 17.550 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 2.962 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 21.26 + 3.38 \times 10^{-3} T - 4.42 \times 10^{-5} T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$400^{\circ}\text{K} \leq T \leq 1050^{\circ}\text{K}$$

$$C_p^{\circ} = 20.79 + 2.75 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1050^{\circ}\text{K} \leq T \leq 1745^{\circ}\text{K}$$

$$C_p^{\circ} = 31.5 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1745^{\circ}\text{K} \leq T \leq 2000^{\circ}\text{K}$$

Structure

The low temperature form is monoclinic, high temperature form is tetragonal.

Heat of Formation

Combustion calorimetry value by Mah¹ was used.

Heat Capacity and Entropy

Low temperature data by King et al.² High temperature data also based on King et al.² Details of analysis given by Barriault et al.³

Melting and Vaporization

Heat of melting from King et al.²

References

1. Mah, A. D., J. Am. Chem. Soc. 81, 1582 (1959).
2. King, E. G., et al., Bur. Mines. Rept. 5664 (1960).
3. Barriault, R., et al., ASD-TR-61-260 (May 1962), Pt. I.

TABLE 214

TUNGSTEN TRIOXIDE

IDEAL MOLECULAR GAS

O₃W

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$. Solid W from 0° to 3650°K,
 Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K; Gaseous O₂;
 Gaseous WO₃.

T, °K	C_p°	S_T°	$\frac{\text{cal/}^\circ\text{K gfw}}{-(T - H_{298})/T}$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-3.296	-64.089	-64.089	INFINITE
298.15	14.936	68.626	68.626	0.000	-65.100	-61.309	44.939
300	14.972	68.718	68.626	0.028	-65.103	-61.286	44.645
400	16.514	73.253	69.234	1.608	-65.175	-59.990	32.776
500	17.487	77.051	70.428	3.311	-65.170	-58.703	25.658
600	18.113	80.299	71.809	5.094	-65.128	-57.401	20.907
700	18.530	83.124	73.228	6.927	-65.075	-56.131	17.524
800	18.818	85.618	74.624	8.795	-65.026	-54.843	14.982
900	19.025	87.847	75.972	10.688	-64.981	-53.591	13.013
1000	19.177	89.860	77.262	12.598	-64.945	-52.306	11.431
1100	19.292	91.693	78.492	14.522	-64.920	-51.065	10.145
1200	19.381	93.376	79.663	16.456	-64.904	-49.782	9.066
1300	19.452	94.930	80.778	18.398	-64.906	-48.549	8.161
1400	19.508	96.374	81.841	20.346	-64.927	-47.292	7.382
1500	19.554	97.721	82.855	22.299	-64.967	-46.031	6.706
1600	19.592	98.985	83.824	24.256	-65.028	-44.766	6.115
1700	19.623	100.173	84.752	26.217	-65.109	-43.500	5.592
1800	19.649	101.296	85.640	28.181	-65.211	-42.226	5.127
1900	19.672	102.359	86.492	30.147	-65.333	-40.943	4.709
2000	19.691	103.368	87.311	32.115	-65.478	-39.656	4.333
2100	19.708	104.329	88.099	34.085	-65.644	-38.359	3.992
2200	19.722	105.247	88.857	36.057	-65.832	-37.055	3.681
2300	19.735	106.124	89.589	38.029	-66.041	-35.742	3.396
2400	19.746	106.964	90.296	40.004	-66.271	-34.426	3.135
2500	19.756	107.770	90.979	41.979	-66.525	-33.093	2.893
2600	19.765	108.544	91.630	43.955	-66.800	-31.749	2.669
2700	19.772	109.291	92.279	45.932	-67.098	-30.391	2.460
2800	19.779	110.010	92.900	47.909	-67.416	-29.028	2.266
2900	19.786	110.705	93.502	49.887	-67.757	-27.652	2.084
3000	19.791	111.375	94.087	51.866	-68.119	-26.265	1.913
3100	19.797	112.024	94.655	53.846	-68.502	-24.856	1.752
3200	19.801	112.653	95.208	55.826	-68.908	-23.450	1.601
3300	19.805	113.262	95.745	57.806	-69.332	-22.044	1.458
3400	19.809	113.854	96.269	59.787	-69.780	-20.577	1.323
3500	19.813	114.428	96.780	61.768	-70.247	-19.117	1.194
3600	19.816	114.986	97.278	63.749	-70.731	-17.647	1.071
3650	19.818	115.258	97.521	64.740	-70.987	-16.907	1.012
3650	19.818	115.258	97.521	64.740	-70.987	-16.907	1.012
3700	19.819	115.525	97.764	65.731	-71.262	-16.058	0.948
3800	19.822	116.058	98.239	67.713	-71.761	-14.634	0.824
3900	19.824	116.573	98.702	69.695	-72.283	-13.189	0.705
4000	19.827	117.075	99.155	71.678	-72.828	-11.736	0.592
4100	19.829	117.564	99.598	73.661	-73.393	-10.277	0.484
4200	19.831	118.042	100.032	75.644	-73.976	-8.813	0.380
4300	19.833	118.509	100.456	77.627	-74.576	-7.344	0.280
4400	19.835	118.965	100.871	79.610	-75.193	-5.870	0.184
4500	19.836	119.410	101.279	81.594	-75.827	-4.391	0.092
4600	19.838	119.846	101.677	83.578	-76.478	-2.906	0.003
4700	19.839	120.273	102.069	85.561	-77.145	-1.417	-0.082
4800	19.841	120.691	102.452	87.545	-77.828	0.074	-0.165
4900	19.842	121.100	102.829	89.530	-78.526	1.563	-0.245
5000	19.843	121.501	103.198	91.514	-79.239	3.048	-0.322
5100	19.844	121.894	103.561	93.498	-79.967	4.529	-0.396
5200	19.845	122.279	103.917	95.483	-80.710	6.006	-0.469
5300	19.846	122.657	104.267	97.467	-81.468	7.479	-0.538
5400	19.847	123.028	104.611	99.452	-82.240	8.948	-0.606
5500	19.848	123.392	104.949	101.437	-83.026	10.413	-0.672
5600	19.849	123.750	105.282	103.422	-83.827	11.874	-0.736
5700	19.850	124.101	105.609	105.407	-84.642	13.331	-0.798
5800	19.851	124.447	105.931	107.392	-85.472	14.784	-0.859
5891	19.852	124.755	106.249	109.377	-86.317	16.233	-0.913
5891	19.852	124.755	106.249	109.377	-86.317	16.233	-0.913
5900	19.852	124.755	106.249	109.377	-86.317	16.233	-0.913
5900	19.852	124.755	106.249	109.377	-86.317	16.233	-0.913
6000	19.852	125.120	106.559	111.362	-87.176	17.682	-1.006

May 1962

CHW

TUNGSTEN TRIOXIDE (WO₃) (IDEAL MOLECULAR GAS) gfw = 231.86

$$\Delta H_{f0}^{\circ} = 64.089 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -65.100 \text{ Kcal gfw}^{-1}$$

Point Group D_{3h}

$$S_{298.15}^{\circ} = 68.626 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.296 \text{ Kcal gfw}^{-1}$$

Vibrational levels and multiplicities

ω, cm^{-1}	ω, cm^{-1}
780 (1)	791 (2)
298 (1)	314 (2)

Bond lengths and angles

W - O distance = 1.78 Å

O - W - O Angle = 120 deg

Product of moments of inertia $I_A I_B I_C = 4.024423 \times 10^{-114} \text{ g}^3 \text{ cm}^6$

Heat of Formation

Based on work of DeMaria et al.¹

Heat Capacity and Entropy

Calculated using above estimated spectroscopic constants. Details are given by Barriault et al.²

References

1. DeMaria, G. et al., J. Chem. Phys. 32, 1373 (1960)
2. Barriault, R. et al., ASD-TR-61-260 (May 1962), Pt. I.

TABLE 215

OSMIUM TETROXIDE

IDEAL MOLECULAR GAS

O₄O₈

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Os from 0° to 3290°K,
Liquid Os from 3290° to 5270°K, Gaseous Os from 5270° to 6000°K, Gaseous O₂: Gaseous OsO₄

T, °K	C_p	S_T	$-(F_T - H_{798}^\circ)/T$	$H_T^\circ - H_{798}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-3.689	-78.829	-78.829	INFINITE
298.15	17.727	70.800	70.800	0.000	-80.500	-70.061	51.353
300	17.776	70.909	70.800	0.033	-80.504	-69.996	50.989
400	19.994	76.345	76.345	1.928	-80.629	-66.469	36.315
500	21.530	80.983	72.965	4.000	-80.618	-62.928	27.504
600	22.581	85.007	74.644	6.218	-80.539	-59.396	21.634
700	23.312	88.546	76.383	8.514	-80.423	-55.882	17.446
800	23.832	91.695	78.103	10.873	-80.295	-52.385	14.310
900	24.211	94.525	79.774	13.276	-80.164	-48.905	11.875
1000	24.495	97.091	81.379	15.712	-80.036	-45.436	9.930
1100	24.717	99.436	82.915	18.173	-79.915	-41.981	8.341
1200	24.881	101.594	84.383	20.653	-79.801	-38.538	7.018
1300	25.015	103.591	85.785	23.148	-79.699	-35.107	5.902
1400	25.123	105.449	87.124	25.655	-79.608	-31.679	4.945
1500	25.211	107.185	88.404	28.172	-79.527	-28.258	4.117
1600	25.284	108.815	89.629	30.697	-79.467	-24.844	3.393
1700	25.345	110.350	90.804	33.228	-79.411	-21.432	2.755
1800	25.397	111.800	91.930	35.765	-79.355	-18.022	2.188
1900	25.441	113.174	93.017	38.307	-79.303	-14.614	1.681
2000	25.478	114.480	94.053	40.853	-79.347	-11.204	1.224
2100	25.511	115.724	95.056	43.403	-79.359	-7.798	0.812
2200	25.539	116.911	96.023	45.955	-79.387	-4.389	0.436
2300	25.564	117.047	96.956	48.511	-79.430	-0.982	0.093
2400	25.588	117.136	97.857	51.068	-79.493	2.432	-0.221
2500	25.605	117.180	98.729	53.628	-79.573	5.845	-0.511
2600	25.622	121.185	99.574	56.189	-79.670	9.268	-0.779
2700	25.637	122.152	100.392	58.752	-79.785	12.688	-1.027
2800	25.651	123.085	101.186	61.316	-79.916	16.117	-1.258
2900	25.663	123.985	101.957	63.882	-80.066	19.547	-1.473
3000	25.674	124.855	102.706	66.449	-80.231	22.985	-1.674
3100	25.684	125.697	103.434	69.017	-80.415	26.434	-1.864
3200	25.693	126.511	104.143	71.586	-80.616	29.878	-2.040
3290	25.701	127.225	104.763	73.898	-80.811	32.992	-2.191
3290	25.701	127.225	104.763	73.898	-88.378	32.992	-2.191
3300	25.702	127.304	104.832	74.155	-88.403	33.363	-2.209
3400	25.709	128.071	105.505	76.726	-88.672	37.055	-2.382
3500	25.716	128.817	106.160	79.297	-88.944	40.761	-2.545
3600	25.723	129.541	106.800	81.869	-89.234	44.467	-2.699
3700	25.729	130.246	107.424	84.442	-89.522	48.186	-2.846
3800	25.734	130.942	108.033	87.015	-89.819	51.919	-2.986
3900	25.739	131.601	108.629	89.589	-90.123	55.649	-3.118
4000	25.744	132.252	109.212	92.163	-90.433	59.392	-3.245
4100	25.748	132.888	109.781	94.737	-90.751	63.143	-3.366
4200	25.752	133.509	110.339	97.313	-91.075	66.903	-3.481
4300	25.756	134.114	110.885	99.888	-91.406	70.671	-3.592
4400	25.760	134.707	111.420	102.464	-91.746	74.442	-3.697
4500	25.763	135.286	111.944	105.040	-92.092	78.220	-3.799
4600	25.766	135.852	112.457	107.616	-92.448	82.023	-3.897
4700	25.769	136.406	112.961	110.193	-92.813	85.819	-3.990
4800	25.771	136.949	113.455	112.770	-93.190	89.626	-4.081
4900	25.774	137.480	113.940	115.347	-93.577	93.440	-4.167
5000	25.776	138.001	114.416	117.925	-93.983	97.265	-4.251
5100	25.779	138.511	114.883	120.503	-94.405	101.096	-4.332
5200	25.781	139.012	115.343	123.081	-94.847	104.937	-4.410
5269.57	25.782	139.356	115.659	124.896	-95.170	107.623	-4.463
5269.57	25.782	139.356	115.659	124.896	-271.571	107.623	-4.463
5300	25.783	139.503	115.794	125.659	-271.709	109.807	-4.528
5400	25.785	139.985	116.237	128.237	-272.146	117.021	-4.736
5500	25.786	140.458	116.673	130.816	-272.700	124.078	-4.930
5600	25.788	140.923	117.102	133.394	-273.261	131.460	-5.130
5700	25.790	141.379	117.524	135.973	-273.874	138.705	-5.318
5800	25.791	141.828	117.939	138.552	-274.554	145.961	-5.500
5900	25.793	142.264	118.348	141.131	-275.310	153.228	-5.676
6000	25.794	142.702	118.750	143.711	-276.155	160.514	-5.846

15 September 1962

CHW

OSMIUM TETROXIDE (OsO_4) (IDEAL MOLECULAR GAS) gfw = 254.2

$$\Delta H_{f0}^{\circ} = -78.829 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = -80.500 \text{ kcal gfw}^{-1}$$

Point Group = T_d

$$S_{298.15}^{\circ} = 70.800 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 3.689 \text{ kcal gfw}^{-1}$$

Vibrational Levels and Multiplicities

$\omega, \text{ cm}^{-1}$	$\omega, \text{ cm}^{-1}$
971 (1)	959.7 (3)
328 (2)	328 (3)

Bond lengths and angles:

$$\text{Os-O distance} = 185 \text{ \AA}$$

Product of moments of inertia:

$$I_A I_B I_C = 1.4250638 \times 10^{-113} \text{ g}^3 \text{ cm}^6 \quad \sigma = 12$$

Heat of Formation

Coughlin's value adopted.¹

Heat Capacity and Entropy

Determined from spectroscopic data. See volume 1, this study (section IVB18.4.4) for details.

Reference

1. Coughlin, J. P., U. S. Bur. Mines, Bull. 542 (1954).

TABLE 216

TANTALUM PENTOXIDE

CONDENSED PHASE



Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Ta from 0° to 3270°K,
Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K, Gaseous O_2 ;
Solid Ta_2O_5 from 0° to 2150°K, Liquid Ta_2O_5 from 2150° to 6000°K.

T, °K	C_p°	S_T°	$\frac{\text{cal/}^\circ\text{K gfw}}{-(F_T^\circ - H_{298}^\circ)/T}$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-5.495	-486.291	-486.291	INFINITE
298.15	32.296	34.200	34.200	0.000	-488.700	-456.453	334.573
300	32.390	34.400	34.201	0.060	-488.694	-456.253	332.364
400	35.924	44.261	35.521	3.496	-488.271	-445.496	243.396
500	37.912	52.508	38.117	7.195	-487.666	-434.869	190.072
600	39.292	59.548	41.117	11.059	-486.976	-424.373	154.570
700	40.384	65.689	44.198	15.044	-486.231	-413.998	129.250
800	41.323	71.144	47.231	19.131	-485.451	-403.732	110.289
900	42.173	76.061	50.166	23.306	-484.631	-393.565	95.566
1000	42.968	80.546	52.983	27.563	-483.776	-383.491	83.808
1100	43.727	84.677	55.679	31.898	-482.877	-373.506	74.205
1200	44.461	88.514	58.257	36.308	-481.937	-363.604	66.218
1300	45.178	92.101	60.724	40.790	-480.955	-353.785	59.474
1400	45.882	95.475	63.087	45.343	-479.932	-344.041	53.705
1500	46.577	98.664	65.353	49.966	-478.870	-334.370	48.715
1600	47.265	101.692	67.531	54.658	-477.769	-324.774	44.360
1700	47.947	104.578	69.626	59.419	-476.627	-315.247	40.526
1800	48.625	107.338	71.645	64.247	-475.452	-305.787	37.126
1900	49.300	109.985	73.593	69.144	-474.236	-296.394	34.091
2000	49.972	112.531	75.477	74.107	-472.993	-287.064	31.367
2100	50.642	114.985	77.300	79.138	-471.719	-277.800	28.910
2150	50.976	116.181	78.191	81.678	-471.070	-273.193	27.769
2150	56.000	132.981	78.191	117.798	-434.950	-273.193	27.769
2200	56.000	134.268	79.450	120.598	-434.052	-269.434	26.764
2300	56.000	136.757	81.888	126.198	-432.290	-261.992	24.894
2400	56.000	139.141	84.225	131.798	-430.575	-254.632	23.186
2500	56.000	141.427	86.467	137.398	-428.923	-247.334	21.621
2600	56.000	143.623	88.624	142.998	-427.319	-240.100	20.181
2700	56.000	145.736	90.700	148.598	-425.798	-232.928	18.853
2800	56.000	147.773	92.702	154.198	-424.367	-225.814	17.625
2900	56.000	149.738	94.635	159.798	-423.053	-218.743	16.484
3000	56.000	151.637	96.504	165.398	-421.873	-211.724	15.423
3100	56.000	153.473	98.312	170.998	-420.844	-204.726	14.432
3200	56.000	155.251	100.064	176.598	-419.981	-197.777	13.507
3270	56.000	156.463	101.258	180.518	-419.470	-192.917	12.893
3270	56.000	156.463	101.258	180.518	-432.878	-92.917	12.893
3300	56.000	156.974	101.762	182.198	-432.433	-190.717	12.630
3400	56.000	158.646	103.411	187.798	-430.958	-183.419	11.789
3500	56.000	160.269	105.012	193.398	-429.493	-176.148	10.999
3600	56.000	161.847	106.569	198.998	-428.038	-168.935	10.255
3700	56.000	163.381	108.084	204.598	-426.591	-161.761	9.554
3800	56.000	164.874	109.559	210.198	-425.153	-154.617	8.892
3900	56.000	166.329	110.996	215.798	-423.726	-147.518	8.266
4000	56.000	167.747	112.397	221.398	-422.306	-140.450	7.673
4100	56.000	169.130	113.764	226.998	-420.896	-133.427	7.112
4200	56.000	170.479	115.098	232.598	-419.496	-126.421	6.578
4300	56.000	171.797	116.402	238.198	-418.103	-119.459	6.071
4400	56.000	173.084	117.675	243.798	-416.723	-112.526	5.589
4500	56.000	174.343	118.921	249.398	-415.351	-105.638	5.130
4600	56.000	175.573	120.139	254.998	-413.991	-98.753	4.692
4700	56.000	176.778	121.331	260.598	-412.643	-91.812	4.274
4800	56.000	177.957	122.499	266.198	-411.311	-85.099	3.874
4900	56.000	179.111	123.642	271.798	-409.993	-78.518	3.493
5000	56.000	180.243	124.763	277.398	-408.696	-71.560	3.128
5100	56.000	181.352	125.862	282.998	-407.421	-64.824	2.778
5200	56.000	182.439	126.939	288.598	-406.171	-58.114	2.442
5300	56.000	183.506	127.997	294.198	-404.953	-51.437	2.121
5400	56.000	184.553	129.034	299.798	-403.773	-44.766	1.812
5500	56.000	185.580	130.053	305.398	-402.636	-38.115	1.514
5600	56.000	186.589	131.054	310.998	-401.533	-31.496	1.229
5700	56.000	187.580	132.037	316.598	-400.533	-24.891	0.954
5706.65	56.000	187.646	132.102	316.971	-400.467	-24.450	0.936
5706.65	56.000	187.646	132.102	316.971	-762.913	-24.450	0.936
5800	56.000	188.554	133.003	322.198	-762.345	-12.366	0.466
5900	56.000	189.512	133.953	327.798	-761.834	0.563	-0.021
6000	56.000	190.453	134.886	333.398	-761.438	13.512	-0.492

15 September 1963

HLS

TANTALUM PENTOXIDE (Ta_2O_5) (CONDENSED PHASE) gfw = 441.90

$$\Delta H_{f298.15}^\circ = -488.7 \pm 0.4 \text{ kcal. gfw}^{-1} \quad S_{298.15}^\circ = 34.2 \pm 0.3 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2150^\circ \text{K}$$

$$\Delta H_m = 36.12 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^\circ - H_0^\circ = 5.495 \text{ kcal gfw}^{-1}$$

$$C_p^\circ = 37.0 + 6.56 \times 10^{-3} T - 5.92 \times 10^{-5} T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^\circ \text{K} \leq T \leq 2150^\circ \text{K}$$

$$C_p^\circ = 56 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2150^\circ \text{K} \leq T \leq 6000^\circ \text{K}$$

Structure

Structure is in doubt. Often orthorhombic structure is quoted.

Heat of Formation

Based on average of Humphrey¹ and Huber et al.²

Heat Capacity and Entropy

Low temperature data is from Kelley.³ High temperature data from Orr⁴ is extrapolated to melting point. Data above melting point is estimated.

Melting and Vaporization

Heat of fusion is estimated.

References

1. Humphrey, G. L., J. Am. Chem. Soc. 76, 978 (1954)
2. Huber, E. J., Jr., et al., J. Phys. Chem 67, 793 (1963)
3. Kelley, K. K., J. Am. Chem. Soc. 62 818 (1940)
4. Orr, R. L., J. Am. Chem. Soc. 75, 2808 (1953)

TANTALUM PENTOXIDE (Ta_2O_5) (CONDENSED PHASE) GFW = 441.90

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±1.000	±0.300	±0.300	±0.000	±0.400		
1000	±1.000	±1.510	±0.808	±0.702			
2000	±1.000	±2.203	±1.352	±1.702			
2150	±1.000	±2.276	±1.414	±1.852			
2150	±4.000	±4.601	±1.414	±6.852			
3000	±4.000	±5.934	±2.517	±10.252			
4000	±4.000	±7.085	±3.522	±14.252			
5000	±4.000	±7.977	±4.327	±18.252			
6000	±4.000	±8.706	±4.998	±22.252			

TABLE 217

TRITITANIUM PENTOXIDE

CONDENSED PHASE

 O_5Ti_3

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
 Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K;
 Gaseous O_2 , Solid Ti_3O_5 from 0° to 2173°K, Liquid Ti_3O_5 from 2173° to 6000°K

T, °K	C_p	S_T	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-5.510	-584.523	-584.523	INFINITE
298.15	44.265	30.900	30.900	0.000	-587.650	-553.778	405.911
300	44.320	31.174	30.901	0.082	-587.633	-553.568	403.255
400	47.270	44.328	32.674	4.461	-586.689	-542.352	296.313
450	48.745	49.981	34.288	7.062	-586.159	-536.878	260.731
450	45.200	54.959	34.288	9.302	-583.919	-536.878	260.731
500	45.600	59.742	36.598	11.572	-583.553	-531.629	232.364
600	46.400	68.126	41.173	16.172	-582.862	-521.309	189.878
700	47.200	75.339	45.551	20.852	-582.206	-511.104	159.566
800	48.000	81.694	49.679	25.612	-581.571	-500.990	136.858
900	48.800	87.394	53.558	30.452	-580.941	-490.954	119.214
1000	49.600	92.577	57.205	35.372	-580.311	-480.987	105.115
1100	50.400	97.341	60.640	40.372	-579.671	-471.088	93.592
1155	50.840	99.811	62.447	43.156	-579.309	-465.666	88.109
1155	50.840	99.811	62.447	43.156	-582.159	-465.666	88.109
1200	51.200	101.761	63.885	45.452	-581.859	-461.132	83.980
1300	52.000	105.891	66.959	50.612	-581.175	-451.104	75.834
1400	52.800	109.774	69.980	55.852	-580.465	-441.123	68.859
1500	53.600	113.444	72.663	61.172	-579.720	-431.198	62.822
1600	54.400	116.929	75.321	66.572	-578.946	-421.321	57.547
1700	55.200	120.251	77.867	72.052	-578.136	-411.493	52.898
1800	56.000	123.428	80.311	77.612	-577.292	-401.716	48.773
1900	56.800	126.478	82.661	83.252	-576.410	-391.983	45.086
1950	57.200	127.958	83.803	86.102	-575.954	-387.132	43.387
1950	57.200	127.958	83.803	86.102	-587.054	-387.132	43.387
2000	57.600	129.411	84.926	88.972	-586.515	-382.016	41.743
2100	58.400	132.241	87.112	94.772	-585.380	-371.819	38.694
2173	58.984	134.247	88.662	99.056	-584.510	-364.412	36.649
2173	60.000	137.256	88.662	14.056	-534.510	-364.412	36.649
2200	60.000	137.997	89.508	150.676	-534.153	-362.299	35.989
2300	60.000	160.664	92.544	156.676	-532.843	-354.519	33.685
2400	60.000	163.218	95.436	162.676	-531.548	-346.790	31.578
2500	60.000	165.667	98.197	168.676	-530.268	-339.124	29.645
2600	60.000	168.020	100.837	174.676	-528.998	-331.494	27.863
2700	60.000	170.285	103.368	180.676	-527.743	-323.929	26.219
2800	60.000	172.467	105.797	186.676	-526.493	-316.397	24.695
2900	60.000	174.572	108.132	192.676	-525.250	-308.915	23.279
3000	60.000	176.607	110.381	198.676	-524.015	-301.478	21.962
3100	60.000	178.574	112.549	204.676	-522.781	-294.075	20.731
3200	60.000	180.479	114.642	210.676	-521.546	-286.720	19.581
3300	60.000	182.327	116.666	216.676	-520.318	-279.340	18.502
3400	60.000	184.116	118.623	222.676	-519.093	-272.101	17.490
3500	60.000	185.856	120.519	228.676	-517.878	-264.847	16.537
3550	60.000	186.707	121.446	231.676	-517.538	-261.238	16.082
3550	60.000	186.707	121.446	231.676	-824.909	-261.238	16.082
3600	60.000	187.546	122.358	234.676	-824.349	-253.302	15.377
3700	60.000	189.190	124.142	240.676	-823.767	-237.452	14.025
3800	60.000	190.790	125.975	246.676	-823.226	-221.628	12.746
3900	60.000	192.348	127.560	252.676	-822.723	-205.846	11.535
4000	60.000	193.867	129.198	258.676	-822.253	-190.068	10.384
4100	60.000	195.349	130.794	264.676	-819.412	-174.325	9.292
4200	60.000	196.795	132.348	270.676	-818.567	-158.595	8.252
4300	60.000	198.207	133.863	276.676	-817.765	-142.984	7.267
4400	60.000	199.586	135.341	282.676	-817.009	-127.194	6.317
4500	60.000	200.934	136.784	288.676	-816.294	-111.541	5.417
4600	60.000	202.253	138.193	294.676	-815.621	-95.869	4.555
4700	60.000	203.544	139.570	300.676	-814.993	-80.238	3.731
4800	60.000	204.807	140.916	306.676	-814.408	-64.601	2.941
4900	60.000	206.044	142.232	312.676	-813.864	-48.976	2.184
5000	60.000	207.256	143.521	318.676	-813.365	-33.375	1.459
5100	60.000	208.444	144.787	324.676	-812.915	-17.776	0.762
5200	60.000	209.609	146.018	330.676	-812.511	-2.192	0.092
5300	60.000	210.752	147.228	336.676	-812.160	13.404	-0.553
5400	60.000	211.874	148.415	342.676	-811.868	28.971	-1.172
5500	60.000	212.975	149.579	348.676	-811.637	44.561	-1.771
5600	60.000	214.056	150.721	354.676	-811.478	60.116	-2.346
5700	60.000	215.118	151.841	360.676	-811.397	75.705	-2.903
5800	60.000	216.161	152.941	366.676	-811.411	91.278	-3.439
5900	60.000	217.187	154.021	372.676	-811.530	106.863	-3.958
6000	60.000	218.195	155.083	378.676	-811.770	122.438	-4.460

31 December 1963

HLS

TRITITANIUM PENTOXIDE (Ti₃O₅) (CONDENSED PHASE) gfw = 223.70

$$\Delta H_{f298.15}^{\circ} = -587.65 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 30.9 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_t = 450^{\circ}\text{K}$$

$$\Delta H_t = 2.240 \text{ kcal gfw}^{-1}$$

$$T_m = 2173^{\circ}\text{K}$$

$$\Delta H_m = 50.0 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 5.510 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 35.47 + 29.50 \times 10^{-3} T \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$298^{\circ}\text{K} \leq T \leq 450^{\circ}\text{K}$$

$$C_p^{\circ} = 41.60 + 8.00 \times 10^{-3} T \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$450^{\circ}\text{K} \leq T \leq 2173^{\circ}\text{K}$$

$$C_p^{\circ} = 60.0 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$2173^{\circ}\text{K} \leq T \leq 6000^{\circ}\text{K}$$

Structure

According to Asbrink and Magneli,¹ the low-temperature form of Ti₃O₅ is monoclinic, and the high-temperature form is of anosovite type.

Heat of Formation

Calorimetric value as compiled by Kelley and Mah² used.

Heat Capacity and Entropy

Low-temperature data by Shomate.³ High-temperature data by Naylor⁴ to 6000°K extrapolated to melting point. Data at higher temperatures estimated.

Melting and Vaporization

Heat of fusion estimated.

References

1. Asbrink, S. and A. Magneli, Acta Cryst. 12, 575 (1959).
2. Kelley, K. and A. Mah, U. S. Bur. Mines, Rept. 5490 (1959).
3. Shomate, C., J. Am. Chem. Soc. 68, 310 (1946).
4. Naylor, B., J. Am. Chem. Soc. 68, 1077 (1946).

TRITITANIUM PENTOXIDE (Ti₃O₅) (CONDENSED PHASE)

GFW = 223.70

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 1.000	± 0.200	± 0.200	± 0.000	± 2.000		
450	± 1.000	± 0.612	± 0.274	± 0.152			
450	± 2.000	± 1.278	± 0.274	± 0.452			
1000	± 2.000	± 2.875	± 1.323	± 1.552			
2000	± 2.000	± 4.262	± 2.406	± 3.552			
2173	± 2.000	± 4.428	± 2.634	± 3.898			
2173	± 5.000	± 9.029	± 2.634	± 13.898			
3000	± 5.000	± 10.642	± 4.631	± 18.033			
4000	± 5.000	± 12.080	± 6.322	± 23.033			
5000	± 5.000	± 13.196	± 7.590	± 28.033			
6000	± 5.000	± 14.108	± 8.602	± 33.033			

RHENIUM HEPTOXIDE

TABLE 218

CONDENSED PHASE

O₇Re₂

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Re from 0° to 3453°K,
 Liquid Re from 3453° to 5961°K, Gaseous Re from 5961° to 6000°K,
 Gaseous O₂, Solid Re₂O₇ from 0° to 570°K, Liquid Re₂O₇ from
 570° to 634°K.

T, °K	$\ln P$	$\frac{cal}{K \cdot gfw}$ S_T°	$(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f° Kcal/gfw	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-7.246	-294.070	-294.070	INFINITE
298.15	39.737	49.543	49.543	0.000	-296.700	-255.032	186.933
300	39.850	49.789	49.544	0.074	-296.693	-254.774	185.594
400	45.344	62.028	51.175	4.341	-296.155	-240.869	131.598
500	50.250	72.680	54.432	9.124	-295.193	-227.150	99.283
570	53.537	79.475	57.095	12.757	-294.300	-217.696	83.465
570	71.100	105.791	57.095	27.757	-279.300	-217.696	83.465
600	71.100	109.438	59.622	29.890	-278.357	-214.463	78.114
634	71.100	113.357	62.400	32.307	-277.299	-210.878	72.689

RHENIUM HEPTOXIDE (Re_2O_7) (CONDENSED PHASE) gfw = 484.44

$\Delta H_f^{\circ} 298.15 = -296.7 \text{ kcal gfw}^{-1}$ $S_{298.15}^{\circ} = 49.54 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$
 $T_m = 570^{\circ}\text{K}$ $\Delta H_m = 15.0 \text{ kcal gfw}^{-1}$
 $T_b = 634^{\circ}\text{K}$ $\Delta H_v = 17.3 \text{ kcal gfw}^{-1}$
 $H_{298.15}^{\circ} - H_0^{\circ} = 7.246 \text{ kcal gfw}^{-1}$
 $C_p^{\circ} = 29.15 + 4.4 \times 10^{-2} T - 2.25 \times 10^{-5} T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 570^{\circ}\text{K}$
 $C_p^{\circ} = 71.10 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \text{ (estimated)} \quad 570^{\circ}\text{K} \leq T \leq 634^{\circ}\text{K}$

Structure

Preliminary investigations of crystal structure indicate an orthorhombic type.¹

Heat of Formation

Heat of formation has been determined by Roth and Becker,² and by Boyd et al.³ The average of these two determinations has been adopted here.

Heat Capacity and Entropy

Entropy at 298°K has been calculated from low-temperature heat-capacity data of Busey.⁴ Heat capacity of solid has been extrapolated to melting point. Heat capacity of liquid is estimated.

Melting and Vaporization

Melting and boiling temperatures have been calculated from vapor-pressure data of Ogawa⁵ and Smith et al.⁶

References

1. Wilhelmi, V., Acta Chem. Scand. 8, 693 (1954).
2. Roth, W. A. and G. Becker, Z. Physik Chem. 159, 27 (1932).
3. Boyd, G. E., J. W. Cobble, and W. T. Smith, Jr., J. Am. Chem. Soc. 75, 5773 (1953).
4. Busey, R. H., J. Am. Chem. Soc. 78, 3263 (1956).
5. Ogawa, E., Bull. Chem. Soc. Japan 7, 265 (1932).
6. Smith, W. T., L. E. Line, and W. A. Bell, J. Am. Chem. Soc. 74, 4964 (1952).

RHENIUM HEPTOXIDE (Re_2O_7) (CONDENSED PHASE) GFW = 484.44

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	Kcal/gfw ΔH_f°	ΔF_f°	Log K_p
298.15	* 0.040	* 0.050	* 0.050	* 0.000	* 2.000		
300	* 0.040	* 0.050	* 0.050	* 0.000			
400	* 0.040	* 0.062	* 0.052	* 0.004			
500	* 0.040	* 0.071	* 0.055	* 0.008			
570	* 0.040	* 0.076	* 0.057	* 0.011			
570	* 1.000	* 0.953	* 0.057	* 0.511			
600	* 1.000	* 1.004	* 0.103	* 0.541			
634	* 1.000	* 1.060	* 0.153	* 0.575			

TABLE 219

OSMIUM

REFERENCE STATE

Os

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Os from 0° to 3290°K,
Liquid Os from 3290° to 5270°K, Gaseous from 5270° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.210			
298.15	5.952	7.800	7.800	0.000			
300	5.954	7.837	7.801	0.011			
400	6.042	9.562	8.035	0.611			
500	6.130	10.919	8.481	1.219			
600	6.218	12.045	8.983	1.837			
700	6.306	13.010	9.491	2.463			
800	6.394	13.858	9.985	3.098			
900	6.482	14.616	10.458	3.742			
1000	6.570	15.303	10.909	4.394			
1100	6.658	15.934	11.338	5.056			
1200	6.746	16.517	11.745	5.726			
1300	6.834	17.060	12.133	6.405			
1400	6.922	17.570	12.504	7.093			
1500	7.010	18.051	12.858	7.789			
1600	7.098	18.506	13.196	8.495			
1700	7.186	18.939	13.522	9.209			
1800	7.274	19.352	13.834	9.932			
1900	7.362	19.748	14.135	10.664			
2000	7.450	20.127	14.425	11.404			
2100	7.538	20.493	14.706	12.154			
2200	7.626	20.846	14.977	12.912			
2300	7.714	21.187	15.239	13.679			
2400	7.802	21.517	15.494	14.455			
2500	7.890	21.837	15.741	15.239			
2600	7.978	22.148	15.982	16.033			
2700	8.066	22.451	16.216	16.835			
2800	8.154	22.746	16.444	17.646			
2900	8.242	23.034	16.666	18.466			
3000	8.330	23.315	16.883	19.294			
3100	8.418	23.589	17.095	20.132			
3200	8.506	23.858	17.302	20.978			
3290	8.585	24.095	17.485	21.747			
3290	9.000	26.395	17.485	29.314			
3300	9.000	26.422	17.512	29.404			
3400	9.000	26.691	17.778	30.304			
3500	9.000	26.952	18.036	31.204			
3600	9.000	27.205	18.287	32.104			
3700	9.000	27.452	18.532	33.004			
3800	9.000	27.692	18.770	33.904			
3900	9.000	27.926	19.001	34.804			
4000	9.000	28.153	19.227	35.704			
4100	9.000	28.376	19.448	36.604			
4200	9.000	28.593	19.663	37.504			
4300	9.000	28.804	19.873	38.404			
4400	9.000	29.011	20.078	39.304			
4500	9.000	29.213	20.279	40.204			
4600	9.000	29.411	20.476	41.104			
4700	9.000	29.605	20.668	42.004			
4800	9.000	29.794	20.856	42.904			
4900	9.000	29.980	21.040	43.804			
5000	9.000	30.162	21.221	44.704			
5100	9.000	30.340	21.398	45.604			
5200	9.000	30.515	21.572	46.504			
5269.57	9.000	30.634	21.690	47.130			
5269.57	8.769	64.110	21.690	223.531			
5300	8.773	64.161	21.935	223.798			
5400	8.809	64.326	22.719	224.677			
5500	8.838	64.488	23.447	225.560			
5600	8.866	64.647	24.210	226.445			
5700	8.893	64.804	24.921	227.333			
5800	8.919	64.959	25.610	228.224			
5900	8.944	65.112	26.279	229.117			
6000	8.968	65.262	26.927	230.012			

15 September 1962

RCF

0°K to 3290°K

3290°K to 5269.57°K

5269.57°K to 6000°K

Crystal

Liquid

Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0 \text{ kcal gfw}^{-1}$$

$$\Delta H_{298.15}^{\circ} = 187.400 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 7.800 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3290^{\circ}\text{K}$$

$$H_m = 7.567 \text{ kcal gfw}^{-1}$$

$$T_b = 5269.57^{\circ}\text{K}$$

$$H_v = 176.401 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.210 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.690 + 0.880 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 3290^{\circ}\text{K}$$

$$C_p^{\circ} = 9.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 3290^{\circ}\text{K} \leq T \leq 5269.57^{\circ}\text{K}$$

Structure

An hcp (A3) type. See volume 1, this study (section IVA18) for details.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Kelley's¹ equation used in compilation and extrapolated to melting point.

Melting

See volume 1, this study (section IVA18) for details.

Vaporization

Data from Panish and Reif.²

References

1. Kelley, K. K., U. S. Bur. Mines, Bull. 584 (1960).
2. Panish, M. B. and L. Reif, J. Chem. Phys. 37, 128 (1962).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.100	±0.500	±0.500	±0.000			
1000	±0.500	±0.740	±0.600	±0.140			
2000	±1.000	±1.260	±0.810	±0.890			
3000	±1.500	±1.770	±0.890	±2.140			
3290	±1.640	±1.910	±1.120	±2.580			
3290	±0.450	±2.270	±1.120	±3.780			
4000	±1.750	±2.490	±1.350	±4.570			
5000	±3.350	±3.080	±1.640	±7.220			
5269.57	±4.050	±3.230	±1.660	±8.290			
5269.57	±0.008	±0.010	±0.005	±0.029			
6000	±0.004	±0.001	±0.006	±0.034			

TABLE 220

OSMIUM

IDEAL MONATOMIC GAS

Os

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Os from 0° to 3290°K,
Liquid Os from 3290° to 5270°K, Gaseous Os from 5270° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-1.481	187.129	187.129	INFINITE
298.15	4.968	46.002	46.002	0.000	187.400	176.010	-129.013
300	4.969	46.032	46.002	0.009	187.398	175.940	-128.460
400	4.974	47.462	46.197	0.506	187.295	172.135	-94.046
500	4.996	48.574	46.565	1.005	187.186	168.358	-73.586
600	5.044	49.489	46.978	1.506	187.069	164.603	-59.954
700	5.122	50.272	47.394	2.014	186.951	160.868	-50.223
800	5.231	50.962	47.798	2.532	186.834	157.150	-42.929
900	5.367	51.586	48.185	3.061	186.719	153.446	-37.260
1000	5.522	52.159	48.554	3.606	186.612	149.755	-32.727
1100	5.691	52.694	48.906	4.166	186.510	146.075	-29.021
1200	5.867	53.196	49.243	4.744	186.418	142.403	-25.934
1300	6.042	53.673	49.565	5.340	186.335	138.738	-23.323
1400	6.211	54.127	49.875	5.952	186.259	135.081	-21.086
1500	6.372	54.561	50.173	6.582	186.193	131.428	-19.148
1600	6.521	54.977	50.460	7.226	186.131	127.778	-17.453
1700	6.658	55.376	50.738	7.885	186.076	124.133	-15.958
1800	6.782	55.761	51.006	8.557	186.025	120.490	-14.629
1900	6.894	56.130	51.266	9.241	185.977	116.851	-13.440
2000	6.996	56.486	51.519	9.936	185.932	113.212	-12.371
2100	7.088	56.830	51.763	10.640	185.887	109.580	-11.404
2200	7.173	57.162	52.001	11.353	185.841	105.948	-10.524
2300	7.251	57.482	52.233	12.074	185.795	102.314	-9.722
2400	7.324	57.793	52.458	12.803	185.748	98.686	-8.986
2500	7.393	58.093	52.677	13.539	185.700	95.060	-8.310
2600	7.459	58.384	52.891	14.282	185.649	91.437	-7.686
2700	7.523	58.667	53.100	15.031	185.596	87.813	-7.108
2800	7.584	58.942	53.304	15.786	185.540	84.192	-6.571
2900	7.645	59.209	53.503	16.548	185.482	80.573	-6.072
3000	7.704	59.469	53.697	17.315	185.421	76.958	-5.606
3100	7.763	59.722	53.888	18.088	185.356	73.342	-5.170
3200	7.821	59.970	54.074	18.868	185.290	69.730	-4.762
3290	7.872	60.188	54.238	19.574	185.227	66.483	-4.416
3290	7.872	60.188	54.238	19.574	177.660	66.483	-4.416
3300	7.878	60.211	54.256	19.653	177.649	66.145	-4.380
3400	7.934	60.447	54.435	20.443	177.539	62.766	-4.034
3500	7.990	60.678	54.610	21.239	177.435	59.391	-3.708
3600	8.045	60.904	54.782	22.041	177.331	56.018	-3.401
3700	8.098	61.125	54.950	22.848	177.244	52.653	-3.110
3800	8.151	61.342	55.115	23.661	177.157	49.289	-2.835
3900	8.203	61.554	55.278	24.478	177.074	45.920	-2.573
4000	8.253	61.763	55.437	25.301	176.997	42.560	-2.325
4100	8.302	61.967	55.594	26.129	176.925	39.201	-2.090
4200	8.350	62.168	55.748	26.962	176.858	35.843	-1.865
4300	8.396	62.365	55.900	27.799	176.795	32.484	-1.651
4400	8.441	62.558	56.049	28.641	176.737	29.128	-1.447
4500	8.484	62.748	56.196	29.487	176.683	25.773	-1.252
4600	8.526	62.935	56.340	30.338	176.634	22.426	-1.065
4700	8.567	63.119	56.482	31.192	176.588	19.074	-0.887
4800	8.605	63.300	56.623	32.051	176.547	15.718	-0.716
4900	8.643	63.478	56.761	32.913	176.509	12.367	-0.552
5000	8.679	63.653	56.897	33.779	176.475	9.020	-0.394
5100	8.713	63.825	57.031	34.649	176.445	5.672	-0.243
5200	8.746	63.994	57.163	35.522	176.418	2.327	-0.098
5269.57	8.769	64.110	57.254	36.131	176.401	0.000	0.000
5269.57	8.769	64.110	57.254	36.131			
5300	8.773	64.161	57.294	36.398			
5400	8.809	64.326	57.422	37.277			
5500	8.838	64.488	57.549	38.160			
5600	8.866	64.647	57.675	39.045			
5700	8.893	64.804	57.798	39.933			
5800	8.919	64.959	57.921	40.824			
5900	8.944	65.112	58.041	41.717			
6000	8.968	65.262	58.160	42.612			

15 September 1962

RCF

OSMIUM (Os)

(IDEAL MONATOMIC GAS)

gfw = 190.2

$$\Delta H_{f0}^{\circ} = 187.129 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 187.400 \text{ kcal gfw}^{-1}$$

Ground State Configuration = $5D_4$

$$S_{298.15}^{\circ} = 46.002 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and MultiplicitiesEnergy levels from Van Kleef. ^{1, 2}Heat of FormationData from Panish and Reif. ³Heat Capacity and Entropy

Calculated from monatomic gas-computer program.

References

1. Van Kleef, T., Koninkl. Ned. Akad. Wetenschap. Proc. B63, 549 (1960).
2. Van Kleef, T. and P. Klinkenberg, Physica 27, 83 (1961).
3. Panish, M. B. and L. Reif, J. Chem. Phys. 37, 128 (1962).

OSMIUM, MONATOMIC (Os)

(IDEAL GAS)

GFW = 190.2

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal / °K gfw			Kcal / gfw			log K _p
	C _p ^o	S _T ^o	-(t _T - H ₂₉₈)/T	H _T - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±0.000	±0.002	±0.002	±0.000	±1.500	±1.650	±0.840
1000	±0.000	±0.002	±0.003	±0.000	±1.640	±2.100	±0.380
2000	±0.002	±0.003	±0.003	±0.001	±2.390	±3.120	±0.290
3000	±0.008	±0.004	±0.003	±0.005	±3.640	±4.170	±0.270
3290	±0.009	±0.005	±0.003	±0.008	±4.090	±5.180	±0.310
3290	±0.009	±0.005	±0.003	±0.008	±5.290	±5.180	±0.310
4000	±0.013	±0.007	±0.004	±0.016	±6.090	±6.900	±0.350
5000	±0.010	±0.010	±0.002	±0.027	±8.750	±9.700	±0.400
5269.57	±0.008	±0.010	±0.005	±0.029	±9.820	±10.250	±0.410
5269.57	±0.008	±0.010	±0.005	±0.029			
6000	±0.004	±0.011	±0.006	±0.034			

TABLE 221

PLATINUM

REFERENCE STATE

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Pt from 0° to 2043°K,
Liquid Pt from 2043° to 4108°K, Gaseous Pt from 4108° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.372			
298.15	6.180	9.950		0.000			
300	6.183	9.988		0.011			
400	6.339	11.790		0.638			
500	6.464	13.218		1.278			
600	6.583	14.407					
700	6.704	15.431		1.931			
800	6.827	16.334		2.595			
900	6.951	17.145		3.271			
1000	7.076	17.884		3.960			
				4.662			
1100	7.201	18.564		5.376			
1200	7.326	19.196		6.102			
1300	7.452	19.788		6.841			
1400	7.577	20.344		7.592			
1500	7.703	20.871		8.356			
1600	7.828	21.373					
1700	7.954	21.851		9.133			
1800	8.080	22.309		9.922			
1900	8.206	22.749		10.724			
2000	8.332	23.173		11.538			
				12.365			
2043	8.386	23.351	17.149	12.724			
2043	8.500	25.651	17.149	17.423			
2100	8.500	25.885	17.358	17.908			
2200	8.500	26.281	17.754	18.758			
2300	8.500	26.658	18.133	19.608			
2400	8.500	27.020	18.496	20.458			
2500	8.500	27.367	18.844	21.308			
2600	8.500	27.701	19.178	22.158			
2700	8.500	28.021	19.500	23.009			
2800	8.500	28.331	19.810	23.858			
2900	8.500	28.629	20.109	24.708			
3000	8.500	28.917	20.398	25.558			
3100	8.500	29.196	20.677	26.408			
3200	8.500	29.466	20.948	27.258			
3300	8.500	29.727	21.210	28.108			
3400	8.500	29.981	21.464	28.958			
3500	8.500	30.227	21.711	29.808			
3600	8.500	30.467	21.951	30.658			
3700	8.500	30.700	22.184	31.508			
3800	8.500	30.926	22.411	32.358			
3900	8.500	31.147	22.632	33.208			
4000	8.500	31.362	22.848	34.058			
4100	8.500	31.572	23.058	34.908			
4108.34	8.500	31.589	23.126	34.979			
4108.34	5.829	61.168	23.126	156.498			
4200	5.850	61.297	23.908	157.032			
4300	5.873	61.435	24.779	157.619			
4400	5.895	61.570	25.614	158.207			
4500	5.917	61.703	26.415	158.798			
4600	5.939	61.833	27.183	159.390			
4700	5.960	61.961	27.922	159.985			
4800	5.982	62.087	28.632	160.583			
4900	6.003	62.210	29.316	161.182			
5000	6.024	62.332	29.975	161.783			
5100	6.046	62.451	30.610	162.387			
5200	6.067	62.569	31.224	162.992			
5300	6.089	62.685	31.817	163.600			
5400	6.111	62.799	32.390	164.210			
5500	6.133	62.911	32.943	164.822			
5600	6.155	63.022	33.480	165.437			
5700	6.178	63.131	33.999	166.053			
5800	6.202	63.239	34.502	166.672			
5900	6.225	63.345	34.990	167.294			
6000	6.250	63.450	35.464	167.917			

15 December 1962

RCF

0°K to 2043°K
2043°K to 4108°K
4108°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{s298.15}^{\circ} = 135.100 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 9.950 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2043^{\circ}\text{K}$$

$$\Delta H_m = 4.699 \text{ kcal gfw}^{-1}$$

$$T_b = 4108^{\circ}\text{K}$$

$$\Delta H_v = 121.519 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.372 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 6.028 + 0.969 \times 10^{-3}T - 0.1220 \times 10^5 T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 500^{\circ}\text{K}$$

$$C_p^{\circ} = 5.810 + 1.260 \times 10^{-3}T - 0.060 \times 10^5 T^{-2} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$500^{\circ}\text{K} \leq T \leq 2043^{\circ}\text{K}$$

$$C_p^{\circ} = 8.500 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2043^{\circ}\text{K} \leq T \leq 4108^{\circ}\text{K}$$

Structure

An f. c. c. (Al) type.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Kelley et al¹ calculated S_{298} and that value adopted. Heat-capacity data based on measurements of several authors. Liquid heat capacity estimated.

Melting and Vaporization

Heat of fusion estimated. Melting point estimated from works of several authors. Heat of vaporization calculated. See volume 1, this study (section IVA20) for details.

Reference

1. Kelley, K. K. and E. G. King, U. S. Bur. Mines, Bull. 592 (1961).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K_p
298.15	±0.020	±0.050	±0.050	±0.000			
1000	±0.020	±0.070	±0.060	±0.010			
2043	±0.100	±0.120	±0.080	±0.080			
2043	±0.420	±0.510	±0.080	±0.880			
3000	±2.050	±0.980	±0.290	±2.060			
4000	±3.750	±1.810	±0.570	±4.960			
4108.34	±3.930	±1.910	±0.610	±5.370			
4108.34	±0.000	±0.003	±0.003	±0.001			
5000	±0.001	±0.003	±0.003	±0.001			
6000	±0.001	±0.003	±0.003	±0.002			

TABLE 222

PLATINUM

IDEAL MONATOMIC GAS

Pt

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Pt from 0° to 2043°K,
Liquid Pt from 2043° to 4108°K, Gaseous Pt from 4108° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.572	134.900	134.900	INFINITE
298.15	6.102	45.962	45.962	0.000	135.100	124.363	-91.156
300	6.113	45.999	45.962	0.011	135.100	124.296	-90.545
400	6.459	47.817	46.207	0.644	135.106	120.695	-65.942
500	6.435	49.260	46.679	1.291	135.113	117.091	-51.178
600	6.260	50.419	47.209	1.926	135.095	113.488	-41.336
700	6.059	51.369	47.738	2.542	135.047	109.890	-34.308
800	5.877	52.166	48.243	3.138	134.966	106.302	-29.039
900	5.728	52.849	48.717	3.718	134.858	102.725	-24.944
1000	5.609	53.446	49.161	4.285	134.723	99.161	-21.671
1100	5.517	53.976	49.575	4.841	134.565	95.612	-18.995
1200	5.447	54.453	49.962	5.389	134.387	92.079	-16.769
1300	5.395	54.887	50.325	5.931	134.190	88.560	-14.888
1400	5.358	55.285	50.665	6.469	133.977	85.058	-13.278
1500	5.333	55.654	50.985	7.003	133.747	81.574	-11.885
1600	5.318	55.998	51.288	7.536	133.503	78.103	-10.668
1700	5.311	56.320	51.575	8.067	133.245	74.646	-9.596
1800	5.310	56.623	51.847	8.598	132.974	71.209	-8.646
1900	5.316	56.911	52.106	9.129	132.691	67.785	-7.797
2000	5.326	57.184	52.353	9.661	132.396	64.376	-7.034
2043	5.332	57.294	52.453	9.891	132.267	62.921	-6.731
2044	5.332	57.294	52.453	9.891	127.568	62.921	-6.731
2100	5.340	57.444	52.589	10.195	127.387	61.115	-6.360
2200	5.356	57.693	52.816	10.729	127.071	57.964	-5.758
2300	5.376	57.931	53.033	11.266	126.758	54.830	-5.210
2400	5.397	58.160	53.242	11.805	126.447	51.710	-4.709
2500	5.421	58.381	53.443	12.346	126.138	48.602	-4.249
2600	5.445	58.594	53.637	12.889	125.831	45.507	-3.825
2700	5.470	58.800	53.824	13.435	125.527	42.425	-3.434
2800	5.496	59.000	54.006	13.983	125.225	39.351	-3.071
2900	5.523	59.193	54.181	14.534	124.926	36.291	-2.735
3000	5.549	59.381	54.351	15.087	124.629	33.241	-2.421
3100	5.576	59.563	54.517	15.644	124.336	30.196	-2.129
3200	5.603	59.740	54.677	16.203	124.045	27.167	-1.855
3300	5.629	59.913	54.833	16.764	123.756	24.144	-1.599
3400	5.655	60.082	54.985	17.328	123.470	21.129	-1.358
3500	5.681	60.246	55.133	17.895	123.187	18.123	-1.132
3600	5.707	60.406	55.277	18.465	122.907	15.126	-0.908
3700	5.732	60.563	55.418	19.037	122.629	12.134	-0.717
3800	5.756	60.716	55.555	19.611	122.353	9.153	-0.526
3900	5.780	60.866	55.690	20.188	122.080	6.174	-0.346
4000	5.804	61.013	55.821	20.767	121.809	3.208	-0.175
4100	5.827	61.156	55.949	21.349	121.541	0.247	-0.013
4108.34	5.829	61.168	55.960	21.398	121.519	0.000	0.000
4108.34	5.829	61.168	55.960	21.398			
4200	5.850	61.297	56.075	21.932			
4300	5.873	61.435	56.198	22.519			
4400	5.895	61.570	56.319	23.107			
4500	5.917	61.703	56.437	23.698			
4600	5.939	61.833	56.553	24.290			
4700	5.960	61.961	56.666	24.885			
4800	5.982	62.087	56.778	25.483			
4900	6.003	62.210	56.888	26.082			
5000	6.024	62.332	56.995	26.683			
5100	6.046	62.451	57.101	27.287			
5200	6.067	62.569	57.205	27.892			
5300	6.089	62.685	57.307	28.500			
5400	6.111	62.799	57.408	29.110			
5500	6.133	62.911	57.507	29.722			
5600	6.155	63.022	57.605	30.337			
5700	6.178	63.131	57.701	30.953			
5800	6.202	63.239	57.795	31.572			
5900	6.224	63.345	57.888	32.194			
6000	6.250	63.450	57.980	32.817			

15 December 1962

RCF

PLATINUM (Pt)

(IDEAL MONATOMIC GAS)

gfw = 195.09

$$\Delta H_{f0}^{\circ} = 134.900 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 135.100 \text{ kcal gfw}^{-1}$$

Ground State Configuration = 3D_3

$$S_{298.15}^{\circ} = 45.962 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.572 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Spectroscopic energy levels from Moore.¹

Heat of Formation

Based on several reported values. See volume 1, this study (section IVA20) for details.

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

Reference

1. Moore, C., Nat. Bur. Stds. (U.S.) Circ. 467, Vol. 3 (May 1958).

PLATINUM, MONATOMIC (Pt)

(IDEAL GAS)

GFW = 195.09

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal. °K gfw			Kcal gfw			log k _p
	C _p	C _v	-(E _T - H ₂₉₈)/T	H _T - H ₂₉₈	ΔH _f	ΔF _f	
298.15	± 0.000	± 0.002	± 0.003	± 0.000	± 0.300	± 0.320	± 0.230
1000	± 0.000	± 0.003	± 0.003	± 0.000	± 0.310	± 0.360	± 0.080
2000	± 0.000	± 0.003	± 0.003	± 0.000			
2043	± 0.000	± 0.003	± 0.003	± 0.000	± 0.380	± 0.470	± 0.050
2043	± 0.000	± 0.003	± 0.003	± 0.000	± 1.180	± 0.470	± 0.050
3000	± 0.000	± 0.003	± 0.003	± 0.001	± 2.360	± 1.180	± 0.090
4000	± 0.000	± 0.003	± 0.003	± 0.001	± 5.260	± 2.590	± 0.140
4108.34	± 0.000	± 0.003	± 0.003	± 0.001	± 5.670	± 2.820	± 0.150
4108.34	± 0.000	± 0.003	± 0.003	± 0.001			
5000	± 0.001	± 0.003	± 0.003	± 0.001			
6000	± 0.001	± 0.003	± 0.003	± 0.002			

TABLE 223

RHENIUM

REFERENCE STATE

Re

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Re from 0° to 3453°K,
Liquid Re from 3453° to 5960°K, Gaseous Re from 5960° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.307			
298.15	6.160	8.886		0.000			
300	6.162	8.924		0.011			
400	6.262	10.710		0.633			
500	6.365	12.119		1.264			
600	6.472	13.289		1.906			
700	6.583	14.295		2.558			
800	6.697	15.181		3.227			
900	6.815	15.977		3.898			
1000	6.936	16.701		4.585			
1100	7.061	17.368		5.285			
1200	7.189	17.988		5.998			
1300	7.321	18.568		6.723			
1400	7.456	19.116		7.462			
1500	7.595	19.635		8.215			
1600	7.738	20.130		8.981			
1700	7.884	20.603		9.762			
1800	8.033	21.058		10.558			
1900	8.186	21.496		11.369			
2000	8.343	21.920		12.195			
2100	8.503	22.331		13.038			
2200	8.667	22.730		13.896			
2300	8.834	23.117		14.771			
2400	9.005	23.499		15.663			
2500	9.179	23.870		16.572			
2600	9.357	24.233		17.499			
2700	9.539	24.590		18.444			
2800	9.723	24.940		19.407			
2900	9.912	25.285		20.389			
3000	10.104	25.624		21.389			
3100	10.300	25.958		22.410			
3200	10.499	26.289		23.450			
3300	10.701	26.615		24.509			
3400	10.908	26.937		25.590			
3453	11.018	27.107		26.171			
3453	11.000	29.407		34.113			
3500	11.000	29.556		34.630			
3600	11.000	29.865		35.730			
3700	11.000	30.167		36.830			
3800	11.000	30.460		37.930			
3900	11.000	30.746		39.030			
4000	11.000	31.024		40.130			
4100	11.000	31.296		41.230			
4200	11.000	31.561		42.330			
4300	11.000	31.820		43.430			
4400	11.000	32.073		44.530			
4500	11.000	32.320		45.630			
4600	11.000	32.562		46.730			
4700	11.000	32.798		47.830			
4800	11.000	33.030		48.930			
4900	11.000	33.257		50.030			
5000	11.000	33.479		51.130			
5100	11.000	33.697		52.230			
5200	11.000	33.910		53.330			
5300	11.000	34.120		54.430			
5400	11.000	34.326		55.530			
5500	11.000	34.527		56.630			
5600	11.000	34.726		57.730			
5700	11.000	34.920		58.830			
5800	11.000	35.112		59.930			
5900	11.000	35.300		61.030			
5960.67	11.000	35.412		61.496			
5960.67	13.157	63.650		230.011			
6000	13.178	63.738		230.530			

15 December 1962

RCF

RHENIUM (Re)

(REFERENCE STATE)

gfw = 186.22

0°K to 3453°K
3453°K to 5960°K
5960°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{298.15} = 185.370 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 8.886 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 3453^{\circ}\text{K}$$

$$\Delta H_m = 7.942 \text{ kcal gfw}^{-1}$$

$$T_b = 5960^{\circ}\text{K}$$

$$\Delta H_v = 168.315 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.307 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.883 + 0.876 \times 10^{-3}T + 0.0177 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 3453^{\circ}\text{K}$$

$$C_p^{\circ} = 11.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$3453^{\circ}\text{K} \leq T \leq 5960^{\circ}\text{K}$$

Structure

An h. c. p. (A3) type.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Entropy based on Keesom et al.¹ High-temperature heat-capacity data of Jaeger et al.² joined to low-temperature data. Liquid heat capacity estimated.

Melting and Vaporization

Heat of fusion estimated. Sims et al.³ melting point adopted. Heat of vaporization calculated and based on Sherwood et al.⁴

References

1. Keesom, P. H. and C. A. Bryant, Phys. Rev. Letters 2, 260 (1959).
2. Jaeger, F. M. and E. Rosenbohm, Proc. Acad. Sci. Amsterdam 36, 786 (1933).
3. Sims, C. T., C. M. Craighead, and R. I. Jaffee, J. Metals 7, 168 (1955).
4. Sherwood, E. M. et al., J. Electrochem. Soc. 102, 650 (1955).

RHENIUM (Re)

(REFERENCE STATE)

GFW = 186.22

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.040	±0.050	±0.050	±0.000			
1000	±0.100	±0.090	±0.070	±0.020			
2000	±0.500	±0.290	±0.130	±0.320			
3000	±1.000	±0.600	±0.240	±1.070			
3453	±1.500	±0.770	±0.300	±1.640			
3453	±1.550	±1.210	±0.300	±3.140			
4000	±1.750	±1.380	±0.440	±3.770			
5000	±3.950	±2.010	±0.690	±6.620			
5960.67	±6.070	±2.890	±0.970	±11.430			
5960.67	±0.009	±0.005	±0.003	±0.012			

TABLE 224

RHENIUM

IDEAL MONATOMIC GAS

Re

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Re from 0° to 3453°K,
Liquid Re from 3453° to 5960°K, Gaseous Re from 5960° to 6000°K

T, °K	C_p°	$\frac{\text{cal/}^\circ\text{K gfw}}{5T}$	$-(F_T^\circ - H_{298}^\circ)/T$	$\frac{\text{Kcal/gfw}}{H_T^\circ - H_{298}^\circ}$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	185.196	185.196	INFINITE
298.15	4.968	45.133	45.133	0.000	185.370	174.563	-127.952
300	4.968	45.163	45.133	0.009	185.368	174.496	-127.114
400	4.968	46.593	45.328	0.506	185.243	170.890	-93.366
500	4.968	47.701	45.696	1.003	185.109	167.318	-73.131
600	4.968	48.607	46.108	1.500	184.964	163.772	-59.651
700	4.968	49.373	46.521	1.996	184.808	160.253	-50.031
800	4.968	50.036	46.920	2.493	184.641	156.756	-42.822
900	4.968	50.622	47.299	2.990	184.462	153.281	-37.220
1000	4.968	51.145	47.658	3.487	184.272	149.827	-32.743
1100	4.968	51.619	47.997	3.984	184.069	146.393	-29.084
1200	4.969	52.051	48.317	4.481	183.853	142.976	-26.038
1300	4.971	52.449	48.620	4.978	183.634	139.579	-23.464
1400	4.974	52.817	48.907	5.475	183.383	136.201	-21.261
1500	4.979	53.160	49.179	5.972	183.127	132.838	-19.354
1600	4.989	53.482	49.438	6.471	182.860	129.495	-17.687
1700	5.004	53.785	49.685	6.970	182.578	126.168	-16.291
1800	5.025	54.071	49.921	7.472	182.284	122.858	-14.916
1900	5.056	54.344	50.146	7.976	181.977	119.567	-13.753
2000	5.097	54.604	50.363	8.483	181.658	116.288	-12.707
2100	5.150	54.854	50.571	8.995	181.327	113.029	-11.762
2200	5.218	55.095	50.771	9.514	180.988	109.785	-10.906
2300	5.301	55.329	50.964	10.040	180.639	106.556	-10.125
2400	5.401	55.557	51.151	10.574	180.281	103.343	-9.410
2500	5.518	55.779	51.331	11.120	179.918	100.145	-8.754
2600	5.655	55.998	51.507	11.679	179.550	96.960	-8.150
2700	5.810	56.215	51.677	12.252	179.178	93.791	-7.591
2800	5.984	56.429	51.843	12.841	178.804	90.635	-7.074
2900	6.178	56.642	52.005	13.449	178.430	87.492	-6.593
3000	6.390	56.855	52.163	14.078	178.059	84.363	-6.146
3100	6.620	57.069	52.318	14.728	177.688	81.247	-5.728
3200	6.866	57.283	52.469	15.402	177.322	78.144	-5.337
3300	7.127	57.498	52.619	16.101	176.962	75.048	-4.970
3400	7.402	57.715	52.765	16.828	176.608	71.966	-4.626
3453	7.552	57.830	52.842	17.224	176.423	70.337	-4.452
3453	7.552	57.830	52.842	17.224	169.481	70.337	-4.452
3500	7.688	57.933	52.910	17.582	168.322	68.998	-4.308
3600	7.984	58.154	53.052	18.366	168.006	66.167	-4.017
3700	8.288	58.377	53.193	19.179	167.719	63.364	-3.741
3800	8.596	58.602	53.333	20.023	167.463	60.525	-3.481
3900	8.908	58.829	53.471	20.899	167.239	57.711	-3.234
4000	9.220	59.059	53.608	21.805	167.045	54.906	-3.000
4100	9.531	59.290	53.743	22.743	166.883	52.108	-2.777
4200	9.838	59.524	53.878	23.711	166.751	49.311	-2.566
4300	10.138	59.759	54.012	24.710	166.650	46.514	-2.364
4400	10.431	59.995	54.145	25.739	166.579	43.721	-2.171
4500	10.714	60.233	54.278	26.796	166.536	40.929	-1.988
4600	10.986	60.471	54.410	27.881	166.521	38.138	-1.812
4700	11.244	60.710	54.542	28.993	166.533	35.346	-1.644
4800	11.489	60.950	54.673	30.129	166.569	32.552	-1.482
4900	11.719	61.189	54.803	31.290	166.630	29.766	-1.328
5000	11.932	61.428	54.933	32.473	166.713	26.970	-1.179
5100	12.110	61.666	55.063	33.676	166.816	24.174	-1.036
5200	12.311	61.903	55.192	34.898	166.938	21.378	-0.898
5300	12.475	62.139	55.321	36.138	167.078	18.574	-0.766
5400	12.623	62.374	55.450	37.393	167.233	15.767	-0.638
5500	12.754	62.607	55.578	38.662	167.402	12.962	-0.515
5600	12.869	62.838	55.705	39.943	167.583	10.157	-0.396
5700	12.968	63.066	55.832	41.235	167.775	7.342	-0.281
5800	13.052	63.293	55.959	42.536	167.976	4.526	-0.171
5900	13.122	63.516	56.085	43.845	168.185	1.709	-0.063
5960.67	13.157	63.650	56.161	44.641	168.315	0.000	0.000
5960.67	13.157	63.650	56.161	44.641			
6000	13.178	63.738	56.211	45.160			

15 December 1962

RCF

RHENIUM (Re)

(IDEAL MONATOMIC GAS)

gfw = 186.22

$$\Delta H_{f0}^{\circ} = 185.196 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 185.370 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = {}^6S_{2\frac{1}{2}}$$

$$S_{298.15}^{\circ} = 45.133 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Spectroscopic energy levels from Moore.¹

Heat of Formation

Third-Law calculation. Sherwood et al² vapor-pressure data.

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

References

1. Moore, C., Nat. Bur. Stds. (U.S.) Circ. 467, Vol. 3 (1958).
2. Sherwood, E. M. et al, J. Electrochem. Soc. 102, 650 (1955).

RHENIUM, MONATOMIC (Re)

(IDEAL GAS)

GFW = 186.22

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal / °K gfw			kcal gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f	ΔF _f	
298.15	±0.000	±0.002	±0.002	±0.000	±1.500	±1.520	±1.110
1000	±0.000	±0.002	±0.003	±0.000	±1.520	±1.570	±0.340
2000	±0.000	±0.002	±0.003	±0.000	±1.820	±1.760	±0.192
3000	±0.001	±0.003	±0.003	±0.001	±2.570	±2.220	±0.160
3453	±0.002	±0.003	±0.003	±0.001	±3.140	±2.540	±0.160
3453	±0.002	±0.003	±0.003	±0.001	±4.640	±2.540	±0.160
4000	±0.003	±0.003	±0.003	±0.002	±5.270	±3.260	±0.180
5000	±0.006	±0.004	±0.003	±0.006	±8.130	±4.950	±0.220
5960.67	±0.009	±0.005	±0.003	±0.012	±12.940	±7.280	±0.270
5960.67	±0.009	±0.005	±0.003	±0.012			

TABLE 225

RHODIUM

REFERENCE STATE

Rh

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Rh from 0° to 2239°K,
Liquid Rh from 2239° to 3996°K, Gaseous Rh from 3996° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.174			
298.15	5.940	7.530	7.530	0.000			
300	5.947	7.567	7.530	0.011			
400	6.262	9.323	7.767	0.622			
500	6.517	10.748	8.225	1.261			
600	6.747	11.957	8.749	1.925			
700	6.966	13.014	9.284	2.611			
800	7.180	13.958	9.811	3.318			
900	7.389	14.816	10.320	4.046			
1000	7.597	15.605	10.809	4.796			
1100	7.803	16.339	11.279	5.566			
1200	8.008	17.026	11.730	6.356			
1300	8.212	17.675	12.162	7.167			
1400	8.416	18.292	12.578	7.999			
1500	8.620	18.879	12.979	8.850			
1600	8.823	19.442	13.365	9.722			
1700	9.026	19.983	13.739	10.615			
1800	9.229	20.505	14.100	11.528			
1900	9.432	21.009	14.451	12.461			
2000	9.634	21.498	14.791	13.414			
2100	9.837	21.973	15.122	14.388			
2200	10.039	22.435	15.444	15.381			
2239	10.118	22.612	15.567	15.774			
2239	10.000	24.912	15.567	20.924			
2300	10.000	25.181	15.818	21.534			
2400	10.000	25.607	16.217	22.534			
2500	10.000	26.015	16.601	23.534			
2600	10.000	26.407	16.971	24.534			
2700	10.000	26.785	17.327	25.534			
2800	10.000	27.148	17.672	26.534			
2900	10.000	27.499	18.005	27.534			
3000	10.000	27.838	18.327	28.534			
3100	10.000	28.166	18.639	29.534			
3200	10.000	28.484	18.942	30.534			
3300	10.000	28.791	19.235	31.534			
3400	10.000	29.090	19.521	32.534			
3500	10.000	29.380	19.798	33.534			
3600	10.000	29.661	20.069	34.534			
3700	10.000	29.935	20.332	35.534			
3800	10.000	30.202	20.588	36.534			
3900	10.000	30.462	20.838	37.534			
3995.85	10.000	30.706	21.072	38.497			
3995.85	6.763	60.269	21.072	156.642			
4000	6.764	60.274	21.108	156.667			
4100	6.778	60.442	22.065	157.344			
4200	6.793	60.606	22.982	158.022			
4300	6.808	60.766	23.859	158.702			
4400	6.823	60.923	24.699	159.384			
4500	6.839	61.076	25.506	160.067			
4600	6.854	61.227	26.281	160.752			
4700	6.870	61.374	27.025	161.438			
4800	6.887	61.519	27.743	162.126			
4900	6.903	61.661	28.434	162.815			
5000	6.920	61.801	29.100	163.506			
5100	6.937	61.938	29.742	164.199			
5200	6.955	62.073	30.363	164.894			
5300	6.971	62.206	30.963	165.590			
5400	6.992	62.336	31.542	166.288			
5500	7.011	62.465	32.104	166.988			
5600	7.030	62.591	32.646	167.691			
5700	7.051	62.716	33.173	168.395			
5800	7.072	62.838	33.683	169.101			
5900	7.093	62.960	34.179	169.809			
6000	7.115	63.079	34.659	170.519			

15 December 1962

RCF

0°K to 2239°K
 2239°K to 3996°K
 3996°K to 6000°K

Crystal
 Liquid
 Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298,15}^{\circ} = 0$$

$$\Delta H_{298,15}^{\circ} = 132.770 \text{ kcal gfw}^{-1}$$

$$S_{298,15}^{\circ} = 7.530 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2239^{\circ}\text{K}$$

$$\Delta H_m = 5.150 \text{ kcal gfw}^{-1}$$

$$T_b = 3996^{\circ}\text{K}$$

$$\Delta H_v = 118.145 \text{ kcal gfw}^{-1}$$

$$H_{298,15}^{\circ} - H_0^{\circ} = 1.174 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.600 + 2.020 \times 10^{-3}T - 0.2334 \times 10^{-5}T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 2239^{\circ}\text{K}$$

$$C_p^{\circ} = 10.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2239^{\circ}\text{K} \leq T \leq 3996^{\circ}\text{K}$$

Structure

An f. c. c. (Al) type.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Kelley and King's¹ S_{298} value adopted. High-temperature heat-capacity equation joined to low-temperature data. See volume 1, this study (section IVA22) for details.

Melting and Vaporization

Heat of fusion estimated. Melting-point values of several authors reported. Heat of vaporization calculated. Several vapor-pressure measurements reported. See volume 1, this study (section IVA22) for details.

Reference

1. Kelley, K. K. and E. G. King, U. S. Bur. Mines, Bull. 592 (1961).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K_p
298.15	± 0.070	± 0.050	± 0.050	± 0.000			
1000	± 0.100	± 0.110	± 0.070	± 0.040			
2000	± 0.200	± 0.220	± 0.120	± 0.190			
2239	± 0.200	± 0.240	± 0.140	± 0.230			
2239	± 0.500	± 0.600	± 0.140	± 1.030			
3000	± 2.000	± 0.960	± 0.300	± 1.980			
3995.89	± 4.000	± 1.820	± 0.580	± 4.970			
3995.89	± 0.001	± 0.003	± 0.003	± 0.002			
5000	± 0.001	± 0.003	± 0.003	± 0.002			
6000	± 0.001	± 0.003	± 0.003	± 0.003			

TABLE 226

RHODIUM

IDEAL MONATOMIC GAS

Rh

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Rh from 0° to 2239°K,
Liquid Rh from 2239° to 3996°K, Gaseous Rh from 3996° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.483	132.461	132.461	INFINITE
298.15	5.023	44.388	44.388	0.000	132.770	121.781	-89.264
300	5.025	44.419	44.388	0.009	132.768	121.713	-88.664
400	5.174	45.883	44.587	0.518	132.666	118.042	-64.492
500	5.386	47.060	44.967	1.046	132.554	114.398	-50.001
600	5.618	48.062	45.402	1.596	132.441	110.778	-40.349
700	5.839	48.945	45.846	2.169	132.328	107.177	-33.461
800	6.034	49.738	46.284	2.763	132.215	103.591	-28.298
900	6.198	50.458	46.708	3.375	132.099	100.021	-24.287
1000	6.329	51.118	47.117	4.002	131.977	96.463	-21.081
1100	6.430	51.727	47.508	4.640	131.844	92.918	-18.460
1200	6.505	52.290	47.884	5.287	131.701	89.384	-16.278
1300	6.558	52.812	48.243	5.940	131.543	85.865	-14.435
1400	6.594	53.300	48.587	6.598	131.369	82.359	-12.856
1500	6.617	53.756	48.917	7.259	131.179	78.863	-11.490
1600	6.629	54.183	49.232	7.921	130.968	75.383	-10.296
1700	6.635	54.585	49.536	8.584	130.739	71.913	-9.245
1800	6.636	54.965	49.827	9.248	130.490	68.461	-8.312
1900	6.634	55.323	50.107	9.911	130.220	65.024	-7.479
2000	6.631	55.663	50.376	10.575	129.931	61.600	-6.731
2100	6.625	55.987	50.636	11.237	129.619	58.191	-6.056
2200	6.623	56.295	50.886	11.900	129.289	54.798	-5.443
2239	6.622	56.410	50.980	12.158	129.154	53.480	-5.220
2239	6.622	56.410	50.980	12.158	124.004	53.480	-5.220
2300	6.620	56.589	51.128	12.562	123.798	51.557	-4.899
2400	6.618	56.871	51.361	13.224	123.460	48.424	-4.409
2500	6.618	57.141	51.587	13.886	123.122	45.305	-3.960
2600	6.620	57.401	51.806	14.548	122.784	42.199	-3.547
2700	6.623	57.651	52.017	15.210	122.446	39.107	-3.165
2800	6.627	57.892	52.223	15.872	122.108	36.027	-2.812
2900	6.634	58.124	52.422	16.535	121.771	32.961	-2.484
3000	6.641	58.349	52.616	17.199	121.435	29.903	-2.178
3100	6.650	58.567	52.805	17.864	121.100	26.855	-1.893
3200	6.660	58.779	52.988	18.529	120.765	23.820	-1.627
3300	6.671	58.984	53.167	19.196	120.432	20.794	-1.377
3400	6.683	59.183	53.341	19.863	120.099	17.782	-1.143
3500	6.695	59.377	53.511	20.532	119.768	14.774	-0.922
3600	6.708	59.566	53.676	21.202	119.438	11.781	-0.715
3700	6.721	59.750	53.838	21.874	119.110	8.794	-0.519
3800	6.735	59.929	53.996	22.547	118.783	5.820	-0.335
3900	6.749	60.104	54.150	23.221	118.457	2.849	-0.160
3995.89	6.763	60.269	54.295	23.872	118.145	0.000	0.000
3995.89	6.763	60.269	54.295	23.872			
4000	6.764	60.275	54.301	23.897			
4100	6.778	60.442	54.449	24.574			
4200	6.793	60.606	54.594	25.252			
4300	6.808	60.766	54.735	25.932			
4400	6.823	60.923	54.874	26.614			
4500	6.839	61.076	55.010	27.297			
4600	6.854	61.227	55.144	27.982			
4700	6.870	61.374	55.275	28.668			
4800	6.887	61.519	55.403	29.3			
4900	6.903	61.661	55.530	30.04			
5000	6.920	61.801	55.654	30.736			
5100	6.937	61.938	55.775	31.429			
5200	6.955	62.073	55.895	32.124			
5300	6.973	62.206	56.013	32.820			
5400	6.992	62.336	56.129	33.518			
5500	7.011	62.465	56.243	34.218			
5600	7.030	62.591	56.355	34.921			
5700	7.051	62.716	56.466	35.625			
5800	7.072	62.838	56.575	36.331			
5900	7.093	62.960	56.682	37.039			
6000	7.115	63.079	56.787	37.749			

15 December 1962

RCF

RHODIUM (Rh)

(IDEAL MONATOMIC GAS)

gfw = 102.91

$$\Delta H_{f0}^{\circ} = 132.461 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 132.770 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = 4F_{4\frac{1}{2}}$$

$$S_{298.15}^{\circ} = 44.388 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.483 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Spectroscopic energy levels from Moore.¹

Heat of Formation

An average of two determinations adopted. See volume 1, this study (section IVA22) for details.

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

Reference

1. Moore, C., Nat. Bur. Stds. (U.S.) Circ. 467, Vol. 3 (May 1958).

RHODIUM, MONATOMIC (Rh)

(IDEAL GAS)

GFW = 102.91

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 1.600	± 1.620	± 1.190
1000	± 0.001	± 0.002	± 0.003	± 0.000	± 1.640	± 1.670	± 0.360
2000	± 0.001	± 0.003	± 0.003	± 0.001	± 1.790	± 1.850	± 0.200
2239	± 0.001	± 0.003	± 0.003	± 0.001	± 1.830	± 1.920	± 0.190
2239	± 0.001	± 0.003	± 0.003	± 0.001	± 2.630	± 1.920	± 0.190
3000	± 0.001	± 0.003	± 0.003	± 0.001	± 3.580	± 2.520	± 0.180
3995.89	± 0.001	± 0.003	± 0.003	± 0.001	± 6.570	± 3.930	± 0.210
3995.89	± 0.001	± 0.003	± 0.003	± 0.002			
4000	± 0.001	± 0.003	± 0.003	± 0.002			
5000	± 0.001	± 0.003	± 0.003	± 0.002			
6000	± 0.001	± 0.003	± 0.003	± 0.003			

TABLE 227

SCANDIUM

REFERENCE STATE

Sc

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Sc from 0° to 1812°K
 Liquid Sc from 1812° to 3021°K, Gaseous Sc from 3021° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.280			
298.15	6.000	9.000	9.000	0.000			
300	6.002	9.037	9.000	0.011			
400	6.110	10.778	9.236	0.617			
500	6.218	12.154	9.688	1.233			
600	6.326	13.297	10.197	1.860			
700	6.434	14.280	10.711	2.498			
800	6.542	15.146	11.212	3.147			
900	6.650	15.923	11.693	3.807			
1000	6.758	16.629	12.152	4.477			
1100	6.866	17.278	12.589	5.158			
1200	6.974	17.880	13.005	5.850			
1300	7.082	18.443	13.402	6.553			
1400	7.190	18.972	13.782	7.267			
1500	7.328	19.471	14.144	7.991			
1600	7.406	19.946	14.492	8.726			
1608	7.415	19.984	14.520	8.786			
1608	8.000	20.202	14.520	9.136			
1700	8.000	20.647	14.840	9.872			
1800	8.000	21.104	15.175	10.677			
1812	8.000	21.158	15.215	10.768			
1812	8.000	23.238	15.215	14.536			
1900	8.000	23.618	15.596	15.242			
2000	8.000	24.028	16.007	16.042			
2100	8.000	24.418	16.398	16.842			
2200	8.000	24.790	16.771	17.642			
2300	8.000	25.146	17.128	18.442			
2400	8.000	25.486	17.468	19.242			
2500	8.000	25.813	17.796	20.042			
2600	8.000	26.127	18.111	20.842			
2700	8.000	26.429	18.413	21.642			
2800	8.000	26.720	18.705	22.442			
2900	8.000	27.000	18.986	23.242			
3000	8.000	27.271	19.257	24.042			
3021	8.000	27.326	19.312	24.210			
3021	6.248	53.651	19.312	103.731			
3100	6.397	53.815	20.193	104.229			
3200	6.599	54.021	21.246	104.879			
3300	6.810	54.227	22.242	105.549			
3400	7.031	54.434	23.187	106.241			
3500	7.259	54.641	24.082	106.955			
3600	7.492	54.849	24.934	107.693			
3700	7.730	55.057	25.745	108.454			
3800	7.969	55.267	26.520	109.239			
3900	8.208	55.477	27.260	110.048			
4000	8.446	55.688	27.968	110.881			
4100	8.680	55.899	28.646	111.737			
4200	8.909	56.111	29.298	112.616			
4300	9.132	56.323	29.923	113.518			
4400	9.347	56.536	30.526	114.442			
4500	9.554	56.748	31.106	115.388			
4600	9.750	56.960	31.666	116.353			
4700	9.936	57.172	32.207	117.337			
4800	10.111	57.383	32.729	118.340			
4900	10.274	57.593	33.234	119.359			
5000	10.425	57.802	33.723	120.394			
5100	10.563	58.010	34.197	121.444			
5200	10.689	58.216	34.657	122.506			
5300	10.803	58.421	35.104	123.581			
5400	10.905	58.624	35.538	124.667			
5500	10.994	58.825	35.959	125.762			
5600	11.072	59.024	36.370	126.865			
5700	11.139	59.220	36.768	127.976			
5800	11.190	59.415	37.158	129.093			
5900	11.242	59.606	37.536	130.215			
6000	11.279	59.796	37.906	131.341			

May 1962

RCF

SCANDIUM (Sc)

(REFERENCE STATE)

gfw = 44.96

0 °K to 1812 °K Crystal

1812 °K to 3021 °K Liquid

3021 °K to 6000 °K Ideal Monatomic Gas

$$\begin{aligned}
 \Delta H_{f0}^{\circ} &= 0 & \Delta H_{f298.15}^{\circ} &= 0 \\
 \Delta H_{298.15}^{\circ} &= 89.500 \text{ Kcal gfw}^{-1} & S_{298.15}^{\circ} &= 9.0 \text{ cal deg}^{-1} \text{ gfw}^{-1} \\
 T_t &= 1608 \text{ °K} & \Delta H_t^{\circ} &= 0.350 \text{ Kcal gfw}^{-1} \\
 T_m &= 1812 \text{ °K} & \Delta H_m^{\circ} &= 3.770 \text{ Kcal gfw}^{-1} \\
 T_b &= 3021 \text{ °K} & \Delta H_v^{\circ} &= 79.521 \text{ Kcal gfw}^{-1} \\
 H_{298.15}^{\circ} - H_0^{\circ} &= 1.280 \text{ Kcal gfw}^{-1} \\
 C_{P0}^{\circ} &= 5.68 + 1.08 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 298.15 \text{ °K} &\leq 1608 \text{ °K} \\
 C_P^{\circ} &= 8.0 \text{ cal deg K}^{-1} \text{ gfw}^{-1} & 1608 \text{ °K} &\leq 3021 \text{ °K}
 \end{aligned}$$

Structure

Low temperature form is h. c. p. ; high temperature form is probably b. c. c.

Heat of Formation

Zero by definition.

Heat Capacity and EntropyLow temperature data estimated by Kelley and King¹. High temperature data estimated by Kelley².MeltingMelting point by Spedding et al.³VaporizationBased on data of Spedding et al.³Further details given by Barriault et al.⁴References

1. Kelley, K., E. King, Bur. Mines. Bull. 592 (1961).
2. Kelley, K., Bur. Mines. Bull. 584 (1960).
3. Spedding, F. H., et al., Trans AIME 218 608 (1960).
4. Barriault, R., et al., ASD-TR-61-260 (May 1962), Pt. I.

SCANDIUM (Sc)

(REFERENCE STATE)

GFW = 44.96

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _P ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
0				± .040			
298.15	± 0.200	± 0.500	± 0.500	± 0.000			
1000	± 0.350	± 0.830	± 0.640	± 0.190			
1608	± 0.500	± 1.090	± 0.800	± 0.460			
1608	± 1.000	± 1.150	± 0.800	± 0.560			
1812	± 1.500	± 1.300	± 0.850	± 0.810			
1812	± 0.400	± 1.410	± 0.850	± 1.010			
3021	± 2.300	± 2.100	± 1.220	± 2.640			
3021	± 0.001	± 0.002					
4000	± 0.002	± 0.003					
5000	± 0.002	± 0.003					
6000	± 0.002	± 0.003					

TABLE 228

SCANDIUM

IDEAL MONATOMIC GAS

Sc

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Sc from 0° to 1812°K,
Liquid Sc from 1812° to 3021°K, Gaseous Sc from 3021° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.674	89.106	89.106	INFINITE
298.15	5.283	41.750	41.750	0.000	89.500	79.736	-58.445
300	5.279	41.783	41.750	0.010	89.499	79.665	-58.033
400	5.148	43.281	41.955	0.530	89.413	76.412	-41.748
500	5.085	44.422	42.339	1.042	89.309	73.174	-31.983
600	5.049	45.346	42.765	1.548	89.188	69.959	-25.480
700	5.028	46.122	43.191	2.052	89.054	66.763	-20.843
800	5.014	46.793	43.600	2.554	88.907	63.590	-17.371
900	5.004	47.383	43.988	3.055	88.748	60.434	-14.675
1000	4.997	47.909	44.355	3.555	88.578	57.297	-12.522
1100	4.992	48.386	44.700	4.054	88.396	54.178	-10.764
1200	4.989	48.820	45.025	4.553	88.203	51.076	-9.302
1300	4.988	49.219	45.333	5.052	87.999	47.990	-8.067
1400	4.989	49.589	45.624	5.551	87.784	44.921	-7.012
1500	4.993	49.933	45.900	6.050	87.559	41.866	-6.100
1600	5.001	50.256	46.162	6.550	87.324	38.828	-5.303
1608	5.002	50.280	46.182	6.590	87.304	38.587	-5.244
1608	5.002	50.280	46.182	6.590	86.954	38.587	-5.244
1700	5.014	50.559	46.412	7.050	86.678	35.828	-4.606
1800	5.034	50.846	46.650	7.553	86.381	32.845	-3.988
1812	5.037	50.879	46.677	7.614	86.346	32.490	-3.919
1812	5.037	50.879	46.677	7.614	82.576	32.490	-3.919
1900	5.062	51.119	46.878	8.058	82.316	30.064	-3.458
2000	5.099	51.380	47.097	8.566	82.074	27.320	-2.985
2100	5.148	51.630	47.307	9.078	81.736	24.591	-2.559
2200	5.208	51.870	47.509	9.595	81.453	21.876	-2.173
2300	5.282	52.103	47.704	10.120	81.178	19.175	-1.822
2400	5.369	52.330	47.892	10.652	80.910	16.482	-1.501
2500	5.472	52.551	48.074	11.194	80.652	13.805	-1.207
2600	5.589	52.768	48.250	11.747	80.405	11.139	-0.936
2700	5.722	52.981	48.421	12.312	80.170	8.478	-0.686
2800	5.869	53.192	48.588	12.892	79.950	5.828	-0.455
2900	6.032	53.401	48.750	13.487	79.745	3.184	-0.240
3000	6.208	53.608	48.909	14.099	79.557	0.544	-0.040
3021	6.248	53.651	48.941	14.231	79.521	0.000	0.000
3021	6.248	53.651	48.941	14.231			
3100	6.397	53.815	49.064	14.729			
3200	6.599	54.021	49.215	15.379			
3300	6.810	54.227	49.364	16.049			
3400	7.031	54.434	49.510	16.741			
3500	7.259	54.641	49.654	17.455			
3600	7.492	54.849	49.795	18.193			
3700	7.730	55.057	49.935	18.954			
3800	7.969	55.267	50.072	19.739			
3900	8.208	55.477	50.208	20.548			
4000	8.446	55.688	50.342	21.381			
4100	8.680	55.899	50.475	22.237			
4200	8.909	56.111	50.607	23.116			
4300	9.132	56.323	50.738	24.018			
4400	9.347	56.536	50.867	24.942			
4500	9.554	56.748	50.995	25.888			
4600	9.750	56.960	51.123	26.849			
4700	9.936	57.172	51.249	27.831			
4800	10.111	57.383	51.375	28.840			
4900	10.274	57.593	51.499	29.859			
5000	10.425	57.802	51.623	30.894			
5100	10.563	58.010	51.747	31.944			
5200	10.689	58.216	51.869	33.006			
5300	10.803	58.421	51.991	34.081			
5400	10.905	58.624	52.112	35.167			
5500	10.994	58.825	52.232	36.262			
5600	11.072	59.024	52.351	37.365			
5700	11.139	59.220	52.470	38.476			
5800	11.196	59.415	52.588	39.593			
5900	11.242	59.606	52.706	40.715			
6000	11.279	59.796	52.822	41.841			

May 1962

RCF

SCANDIUM, MONATOMIC (Sc) (IDEAL GAS)

gfw = 44.96

$$\Delta H_{f0}^{\circ} = 89.106 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 89.500 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $^2D_{1-1/2}$

$$S_{298.15}^{\circ} = 41.750 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.674 \text{ Kcal gfw}^{-1}$$

Electronic levels and multiplicitiesSource of DataEnergy Levels .. Moore¹.Heat of FormationBased on vaporization data of Spedding et al².Heat Capacity and Entropy

Calculated using monatomic gas computer program.

Further details given by Barriault et al³.References

1. Moore, C., Atomic Energy Levels, Vol. 1, Nat. Bur. Stds. (1949).
2. Spedding, F. H., et al, Trans. AIME 218, 608 (1960).
3. Barriault, R. et al, ASD TR-61-260 (May 1962), Pt. I.

SCANDIUM, MONATOMIC (Sc)

(IDEAL GAS)

GFW = 44.96

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 0.650	± 0.480
1000	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 1.060	± 0.230
1608	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 1.790	± 0.240
1608	± 0.000	± 0.002	± 0.002	± 0.000	± 0.600	± 1.790	± 0.240
1812	± 0.000	± 0.002	± 0.003	± 0.000	± 0.850	± 1.940	± 0.230
1812	± 0.000	± 0.002	± 0.003	± 0.000	± 1.050	± 1.940	± 0.230
3021	± 0.001	± 0.002	± 0.003	± 0.001	± 2.680	± 3.690	± 0.270
3021	± 0.001	± 0.002	± 0.003	± 0.001			
4000	± 0.002	± 0.003	± 0.003	± 0.002			
5000	± 0.002	± 0.003	± 0.003	± 0.004			
6000	± 0.002	± 0.003	± 0.003	± 0.005			

TABLE 229

SILICON

REFERENCE STATE

SI

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Si from 0° to 1690°K,
Liquid Si from 1690° to 3566°K, Gaseous Si from 3566° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-0.769			
298.15	4.739	4.530	4.530	0.000			
300	4.754	4.559	4.530	0.009			
400	5.330	6.017	4.725	0.517			
500	5.634	7.242	5.109	1.066			
600	5.831	8.287	5.554	1.640			
700	5.981	9.198	6.011	2.231			
800	6.114	10.005	6.440	2.836			
900	6.232	10.732	6.895	3.453			
1000	6.340	11.394	7.313	4.082			
1100	6.441	12.003	7.712	4.721			
1200	6.536	12.568	8.093	5.370			
1300	6.628	13.095	8.458	6.028			
1400	6.718	13.589	8.807	6.695			
1500	6.806	14.056	9.142	7.372			
1600	6.881	14.498	9.463	8.057			
1690	6.974	14.877	9.741	8.681			
1690	6.973	21.948	9.741	20.631			
1700	6.981	21.989	9.813	20.700			
1800	7.068	22.391	10.501	21.403			
1900	7.144	22.775	11.137	22.114			
2000	7.144	23.143	11.728	22.831			
2100	7.115	23.492	12.280	23.546			
2200	7.115	23.825	12.797	24.262			
2300	7.155	24.143	13.283	24.977			
2400	7.115	24.448	13.742	25.693			
2500	7.115	24.740	14.176	26.408			
2600	7.115	25.020	14.588	27.124			
2700	7.155	25.290	14.979	27.839			
2800	7.155	25.550	15.352	28.555			
2900	7.155	25.802	15.708	29.270			
3000	7.155	26.044	16.049	29.986			
3100	7.155	26.279	16.375	30.701			
3200	7.155	26.506	16.688	31.417			
3300	7.155	26.726	16.989	32.132			
3400	7.155	26.940	17.279	32.848			
3500	7.155	27.147	17.558	33.563			
3565.77	7.155	27.280	17.736	34.033			
3565.77	5.506	52.939	17.736	125.528			
3600	5.508	52.992	18.071	125.716			
3700	5.513	53.143	19.017	126.267			
3800	5.516	53.291	19.917	126.819			
3900	5.519	53.434	20.774	127.371			
4000	5.521	53.574	21.593	127.922			
4100	5.522	53.710	22.374	128.475			
4200	5.522	53.843	23.123	129.027			
4300	5.522	53.973	23.838	129.579			
4400	5.522	54.100	24.525	130.131			
4500	5.521	54.224	25.184	130.683			
4600	5.520	54.345	25.816	131.236			
4700	5.518	54.464	26.424	131.787			
4800	5.517	54.580	27.009	132.339			
4900	5.515	54.694	27.573	132.891			
5000	5.513	54.805	28.117	133.442			
5100	5.512	54.915	28.642	133.994			
5200	5.510	55.022	29.148	134.545			
5300	5.509	55.126	29.637	135.096			
5400	5.508	55.229	30.110	135.646			
5500	5.508	55.331	30.568	136.197			
5600	5.507	55.430	31.011	136.748			
5700	5.508	55.527	31.439	137.299			
5800	5.509	55.623	31.856	137.850			
5900	5.511	55.717	32.260	138.401			
6000	5.514	55.810	32.651	138.952			

15 March 1963

HLS

0°K to 1690°K
1690°K to 3565.77°K
3565.77°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 108.407 \text{ Kcal gfw}^{-1}$$

$$T_m = 1690^{\circ}\text{K}$$

$$T_b = 3565.77^{\circ}\text{K}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 0.769 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$S_{298.15}^{\circ} = 4.53 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$\Delta H_m = 11.950 \text{ Kcal gfw}^{-1}$$

$$\Delta H_v = 91.495 \text{ Kcal gfw}^{-1}$$

C_p° data was selected and smoothed (See below).

Structure

Silicon has a cubic A4 (i. e., diamond type) structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low temperature data from Stull and Sinke.¹ Kelley's² equation used to 600°K. From 600° to 1900°K, the data of Kantor et al³ joined Kelley's data. Above 1900°K estimated data were used.

Melting

Data of Kantor et al³ were used.

Heat of Sublimation

Several sources were reviewed. See gas table (table 230), this volume, also see volume 1, this study (section IVA25).

References

1. Stull, D. R. and G. C. Sinke, Thermodynamic Properties of the Elements (1956).
2. Kelley, K. K., Bur. Mines, Bull. 584 (1960).
3. Kantor, P. B., O. M. Kisil and E. M. Fomichov, Ukr. Fiz. Zh. 5, 358-362 (1960).

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	± 0.100	± 0.050	± 0.050	± 0.000			
1000	± 0.100	± 0.171	± 0.101	± 0.070			
1000	± 0.500	± 0.171	± 0.101	± 0.070			
1690	± 0.500	± 0.433	± 0.188	± 0.415			
1690	± 0.500	± 0.552	± 0.188	± 0.615			
1900	± 0.500	± 0.610	± 0.231	± 0.720			
1900	± 1.000	± 0.610	± 0.231	± 0.720			
2000	± 1.000	± 0.662	± 0.231	± 0.820			
3000	± 1.000	± 1.067	± 0.460	± 1.820			
3565.77	± 1.000	± 1.240	± 0.571	± 2.386			

TABLE 230

SILICON

IDEAL MONATOMIC GAS

Si

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Si from 0° to 1690°K,
Liquid Si from 1690° to 3566°K, Gaseous Si from 3566° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-1.805	107.371	107.371	INFINITE
298.15	5.319	40.123	40.123	0.000	108.407	97.795	-71.682
300	5.315	40.156	40.123	0.010	108.408	97.729	-71.192
400	5.166	41.662	40.330	0.533	108.423	94.165	-51.447
500	5.095	42.806	40.715	1.046	108.387	90.604	-39.601
600	5.056	43.731	41.143	1.553	108.320	87.054	-31.708
700	5.033	44.509	41.570	2.057	108.233	83.516	-26.074
800	5.019	45.180	41.980	2.560	108.131	79.991	-21.851
900	5.012	45.770	42.369	3.061	108.015	76.480	-18.571
1000	5.012	46.299	42.736	3.563	107.888	72.984	-15.950
1100	5.017	46.776	43.082	4.064	107.750	69.500	-13.808
1200	5.027	47.213	43.408	4.566	107.603	66.029	-12.025
1300	5.043	47.616	43.717	5.070	107.449	62.570	-10.519
1400	5.063	47.991	44.009	5.575	107.287	59.124	-9.229
1500	5.087	48.341	44.286	6.082	107.117	55.691	-8.114
1600	5.113	48.670	44.550	6.592	106.942	52.268	-7.139
1690	5.139	48.950	44.777	7.054	106.780	49.196	-6.362
1690	5.139	48.950	44.777	7.054	94.830	49.196	-6.362
1700	5.142	48.981	44.801	7.105	94.812	48.927	-6.290
1800	5.172	49.276	45.042	7.621	94.625	46.233	-5.613
1900	5.202	49.556	45.272	8.139	94.432	43.551	-5.009
2000	5.232	49.824	45.493	8.661	94.237	40.877	-4.467
2100	5.261	50.080	45.705	9.186	94.047	38.215	-3.977
2200	5.289	50.325	45.910	9.713	93.858	35.558	-3.532
2300	5.316	50.561	46.107	10.243	93.673	32.912	-3.127
2400	5.341	50.787	46.297	10.776	93.490	30.275	-2.757
2500	5.365	51.006	46.481	11.312	93.311	27.645	-2.417
2600	5.386	51.217	46.659	11.849	93.132	25.022	-2.103
2700	5.406	51.420	46.832	12.389	92.957	22.404	-1.813
2800	5.424	51.617	46.999	12.930	92.782	19.795	-1.545
2900	5.440	51.808	47.162	13.473	92.610	17.190	-1.295
3000	5.454	51.993	47.320	14.018	92.439	14.594	-1.063
3100	5.467	52.172	47.473	14.564	92.270	12.003	-0.846
3200	5.478	52.345	47.623	15.111	92.101	9.415	-0.643
3300	5.487	52.514	47.769	15.660	91.935	6.833	-0.453
3400	5.495	52.678	47.911	16.209	91.768	4.258	-0.274
3500	5.502	52.837	48.049	16.759	91.603	1.689	-0.105
3565.77	5.506	52.939	48.138	17.121	91.495	0.000	0.000
3565.77	5.506	52.939	48.138	17.121			
3600	5.508	52.992	48.184	17.309			
3700	5.513	53.143	48.316	17.860			
3800	5.516	53.291	48.445	18.412			
3900	5.519	53.434	48.571	18.964			
4000	5.521	53.574	48.695	19.515			
4100	5.522	53.710	48.815	20.068			
4200	5.522	53.843	48.934	20.620			
4300	5.522	53.973	49.049	21.172			
4400	5.522	54.100	49.163	21.724			
4500	5.521	54.224	49.274	22.276			
4600	5.520	54.345	49.383	22.829			
4700	5.518	54.464	49.489	23.380			
4800	5.517	54.580	49.594	23.932			
4900	5.515	54.694	49.697	24.484			
5000	5.513	54.805	49.798	25.035			
5100	5.512	54.915	49.898	25.587			
5200	5.510	55.022	49.995	26.138			
5300	5.509	55.126	50.091	26.689			
5400	5.508	55.229	50.185	27.239			
5500	5.508	55.331	50.278	27.790			
5600	5.507	55.430	50.369	28.341			
5700	5.508	55.527	50.458	28.892			
5800	5.509	55.623	50.547	29.443			
5900	5.511	55.717	50.634	29.994			
6000	5.514	55.810	50.719	30.545			

15 March 1963

HLS

$$\Delta H_{f0}^{\circ} = 107.371 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $3P_0$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.805 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 108.407 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 40.123 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

All energy levels from Moore¹ were used to calculate functions in an earlier report.²

Heat of Formation

Based on vapor pressure data of Davis et al.³ Several other sources of data were reviewed and are discussed in volume 1, this study (section IVA25).

Heat Capacity and Entropy

Calculated in an earlier report.²

References

1. Moore, C., Nat. Bur. Std. (U.S.), Circ. 467, Vol. 1 (1949).
2. Barriault, R. J. et al, Thermodynamics of Certain Refractory Compounds Pt. I, Vol. 1, ASD TR-61-260 (May 1962).
3. Davis, S. G., D. F. Anthrop and A. W. Searcy, J. Chem. Phys. 34, 659 (1961).

SILICON, MONATOMIC (Si)

(IDEAL GAS)

GFW = 28.09

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 3.000		
1000	± 0.000	± 0.002	± 0.002	± 0.000			
2000	± 0.000	± 0.002	± 0.002	± 0.000			
3000	± 0.000	± 0.002	± 0.003	± 0.001			
4000	± 0.000	± 0.002	± 0.003	± 0.001			
5000	± 0.000	± 0.002	± 0.003	± 0.001			
6000	± 0.001	± 0.003	± 0.003	± 0.002			

TABLE 231

STRONTIUM

REFERENCE STATE

Sr

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Sr from 0° to 1045°K,
Liquid Sr from 1045° to 1641°K, Gaseous Sr from 1641° to 6000°K

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.550			
298.15	6.400	12.500	12.500	0.000			
300	6.407	12.540	12.501	0.012			
400	6.807	14.438	12.757	0.673			
500	7.207	15.999	13.253	1.373			
600	7.607	17.349	13.826	2.114			
700	8.007	18.551	14.416	2.895			
800	8.407	19.647	15.003	3.715			
862	8.655	20.283	15.359	4.244			
862	9.160	20.515	15.359	4.444			
900	9.160	20.910	15.586	4.792			
1000	9.160	21.875	16.167	5.708			
1045	9.160	22.278	16.421	6.120			
1045	7.800	24.163	16.421	8.090			
1100	7.800	24.563	16.818	8.519			
1200	7.800	25.242	17.493	9.299			
1300	7.800	25.866	18.113	10.079			
1400	7.800	26.444	18.688	10.859			
1500	7.800	26.982	19.223	11.639			
1600	7.800	27.486	19.724	12.419			
1641	7.800	27.680	19.922	12.731			
1641	4.977	47.797	19.922	45.743			
1700	4.981	47.975	20.895	46.036			
1800	4.991	48.260	22.407	46.535			
1900	5.007	48.530	23.775	47.035			
2000	5.031	48.787	25.019	47.537			
2100	5.065	49.033	26.156	48.041			
2200	5.111	49.270	27.202	48.550			
2300	5.171	49.499	28.167	49.064			
2400	5.249	49.720	29.060	49.587			
2500	5.345	49.936	29.890	50.114			
2600	5.461	50.148	30.666	50.654			
2700	5.600	50.357	31.391	51.207			
2800	5.762	50.563	32.072	51.775			
2900	5.949	50.769	32.713	52.361			
3000	6.159	50.974	33.319	52.966			
3100	6.394	51.180	33.892	53.593			
3200	6.653	51.387	34.435	54.245			
3300	6.933	51.596	34.952	54.924			
3400	7.235	51.807	35.444	55.633			
3500	7.556	52.021	35.915	56.372			
3600	7.894	52.239	36.365	57.144			
3700	8.247	52.460	36.797	57.951			
3800	8.611	52.685	37.213	58.794			
3900	8.984	52.913	37.612	59.674			
4000	9.364	53.145	37.997	60.591			
4100	9.747	53.381	38.370	61.547			
4200	10.131	53.621	38.730	62.541			
4300	10.513	53.864	39.080	63.577			
4400	10.891	54.110	39.418	64.663			
4500	11.262	54.359	39.748	65.791			
4600	11.625	54.610	40.068	66.895			
4700	11.979	54.864	40.380	68.076			
4800	12.320	55.120	40.684	69.331			
4900	12.650	55.377	40.981	70.659			
5000	12.965	55.636	41.272	71.820			
5100	13.267	55.896	41.556	73.112			
5200	13.554	56.156	41.833	74.473			
5300	13.826	56.417	42.107	75.842			
5400	14.082	56.678	42.374	77.238			
5500	14.324	56.938	42.636	78.658			
5600	14.550	57.198	42.894	80.102			
5700	14.762	57.458	43.148	81.568			
5800	14.959	57.716	43.396	83.054			
5900	51.141	57.974	43.642	84.559			
6000	15.309	58.230	43.883	86.081			

May 1962

RCF

STRONTIUM (Sr)

(REFERENCE STATE)

gfw = 87.63

0 °K to 1045 °K Crystal

1045 °K to 1641 °K Liquid

1641 °K to 6000 °K Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 39.070 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 12.5 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_f = 862 \text{ °K}$$

$$\Delta H_f = 0.200 \text{ Kcal gfw}^{-1}$$

$$T_m = 1045 \text{ °K}$$

$$\Delta H_m = 1.970 \text{ Kcal gfw}^{-1}$$

$$T_b = 1641 \text{ °K}$$

$$\Delta H_v = 33.012 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.550 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.207 + 4.00 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 862^{\circ}\text{K}$$

$$C_p^{\circ} = 9.16 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 862^{\circ}\text{K} \leq T \leq 1045^{\circ}\text{K}$$

$$C_p^{\circ} = 7.80 \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 1045^{\circ}\text{K} \leq T \leq 1641^{\circ}\text{K}$$

Structure

Low-temperature form (α - Sr) has f. c. c. structure; high-temperature form (γ - Sr) has b. c. c. structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data estimated by Kelley and King.¹ High-temperature data were estimated.

Melting

Average of three melting point values was used.

Vaporization-pressure determinations were averaged; see Barriault² for details.

References

1. Kelley, K. and E. King, Bur. Mines. Bull. 592 (1961).
2. Barriault, R., et al, ASD-TR-61-260 (May 1962), Pt. 1.

STRONTIUM (Sr)

(REFERENCE STATE)

GFW = 87.63

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔI_f°	
298.15	± 0.200	± 0.500	± 0.500	± 0.000			
862	± 0.300	± 0.610	± 0.540	± 0.060			
862	± 0.600	± 0.730	± 0.540	± 0.160			
1045	± 1.000	± 0.760	± 0.580	± 0.190			
1045	± 0.500	± 0.910	± 0.580	± 0.340			
1641	± 1.500	± 1.130	± 0.740	± 0.640			
1641	± 0.000	± 0.002					
2000	± 0.000	± 0.002					
3000	± 0.001	± 0.002					
4000	± 0.002	± 0.003					
5000	± 0.003	± 0.003					
6000	± 0.003	± 0.003					

TABLE 232

STRONTIUM

IDEAL MONATOMIC GAS

Sr

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Sr from 0° to 1045°K,
Liquid Sr from 1045°K to 1641°K, Gaseous Sr from 1641° to 6000°K

T, °K	C_p	S_T	$-(F_T - H_{298}^\circ)/T$	$H_T - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.481	39.139	39.139	INFINITE
298.15	4.968	39.325	39.325	0.000	39.070	31.072	-22.775
300	4.968	39.356	39.325	0.009	39.067	31.023	-22.599
400	4.968	40.785	39.520	0.506	38.903	28.365	-15.497
500	4.968	41.894	39.888	1.003	38.700	25.752	-11.256
600	4.968	42.799	40.300	1.500	38.456	23.186	-8.445
700	4.968	43.565	40.713	1.996	38.171	20.662	-6.451
800	4.968	44.229	41.122	2.493	37.848	18.183	-4.967
862	4.968	44.600	41.350	2.801	37.627	16.666	-4.225
862	4.968	44.600	41.350	2.801	37.427	16.666	-4.225
900	4.968	44.814	41.492	2.990	37.268	15.755	-3.826
1000	4.968	45.337	41.850	3.487	36.849	13.387	-2.926
1045	4.968	45.556	42.005	3.711	36.661	12.335	-2.580
1045	4.968	45.556	42.005	3.711	34.691	12.335	-2.580
1100	4.968	45.811	42.189	3.984	34.535	11.162	-2.218
1200	4.968	46.243	42.509	4.481	34.252	9.051	-1.648
1300	4.969	46.641	42.812	4.977	33.968	6.961	-1.170
1400	4.969	47.009	43.099	5.474	33.685	4.895	-0.764
1500	4.971	47.352	43.371	5.971	33.402	2.848	-0.415
1600	4.975	47.673	43.630	6.466	33.120	0.82	-0.112
1641	4.977	47.797	43.731	6.673	32.712	0.000	0.000
1641	4.977	47.797	43.731	6.673			
1700	4.981	47.975	43.877	6.966			
1800	4.991	48.260	44.112	7.465			
1900	5.007	48.530	44.338	7.965			
2000	5.031	48.787	44.554	8.467			
2100	5.065	49.033	44.761	8.971			
2200	5.111	49.270	44.961	9.480			
2300	5.171	49.499	45.153	9.994			
2400	5.249	49.720	45.339	10.515			
2500	5.345	49.936	45.519	11.044			
2600	5.461	50.148	45.693	11.584			
2700	5.600	50.357	45.862	12.137			
2800	5.762	50.563	46.026	12.705			
2900	5.949	50.769	46.186	13.291			
3000	6.159	50.974	46.342	13.896			
3100	6.394	51.180	46.495	14.523			
3200	6.653	51.387	46.644	15.175			
3300	6.933	51.596	46.791	15.854			
3400	7.235	51.807	46.936	16.563			
3500	7.556	52.021	47.078	17.302			
3600	7.894	52.239	47.218	18.074			
3700	8.247	52.460	47.357	18.881			
3800	8.611	52.685	47.494	19.724			
3900	8.984	52.913	47.630	20.604			
4000	9.364	53.145	47.765	21.521			
4100	9.747	53.381	47.899	22.477			
4200	10.131	53.621	48.033	23.471			
4300	10.513	53.864	48.165	24.503			
4400	10.891	54.110	48.298	25.573			
4500	11.262	54.359	48.430	26.681			
4600	11.625	54.610	48.561	27.825			
4700	11.979	54.864	48.693	29.000			
4800	12.320	55.120	48.824	30.221			
4900	12.650	55.377	48.955	31.469			
5000	12.965	55.636	49.086	32.750			
5100	13.267	55.896	49.217	34.062			
5200	13.554	56.156	49.348	35.403			
5300	13.826	56.417	49.479	36.772			
5400	14.085	56.678	49.610	38.168			
5500	14.324	56.938	49.741	39.588			
5600	14.550	57.198	49.871	41.032			
5700	14.762	57.458	50.002	42.498			
5800	14.959	57.716	50.133	43.984			
5900	14.141	57.974	50.264	45.489			
6000	15.309	58.230	50.394	47.011			

May 1962

RCF

STRONTIUM, MONATOMIC (Sr) (IDEAL GAS)

gfw = 87.63

$$\Delta H_{f0}^{\circ} = 39.139 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 39.070 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $1S_0$

$$S_{298.15}^{\circ} = 39.325 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic levels and multiplicities

Source of Data

Energy levels from Moore¹.

Heat of Formation

Average of two vapor pressure determinations. Details by Barriault et al².

Heat Capacity and Entropy

Calculated using monatomic gas computer program.

References

1. Moore, C., Atomic Energy Levels, Vol. II Nat. Bur. Stds. (1952).
2. Barriault, R., et al, ASD-TR-61-260 (May 1962), Pt. I.

STRONTIUM, MONATOMIC (Sr)

(IDEAL GAS)

GFW = 87.63

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 0.560	± 0.410
862	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 1.000	± 0.250
862	± 0.000	± 0.002	± 0.002	± 0.000	± 0.500	± 1.000	± 0.250
1045	± 0.000	± 0.002	± 0.002	± 0.000	± 0.600	± 1.200	± 0.250
1045	± 0.000	± 0.002	± 0.002	± 0.000	± 0.750	± 1.200	± 0.250
1641	± 0.000	± 0.002	± 0.002	± 0.000	± 1.050	± 1.800	± 0.240
1641	± 0.000	± 0.002	± 0.002	± 0.000			
2000	± 0.000	± 0.002	± 0.002	± 0.000			
3000	± 0.001	± 0.002	± 0.002	± 0.001			
4000	± 0.002	± 0.003	± 0.003	± 0.002			
5000	± 0.003	± 0.003	± 0.003	± 0.004			
6000	± 0.003	± 0.003	± 0.003	± 0.006			

TABLE 233

TANTALUM

REFERENCE STATE

Ta

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Ta from 0° to 3270°K,
Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.358			
298.15	6.069	9.920	9.920	0.000			
300	6.074	9.958	9.920	0.000			
400	6.270	11.735	10.161	0.011			
500	6.382	13.147	10.622	0.630			
600	6.461	14.318	11.143	1.905			
700	6.525	15.319	11.670	2.554			
800	6.580	16.194	12.182	3.210			
900	6.630	16.972	12.672	3.870			
1000	6.673	17.673	13.137	4.536			
1100	6.720	18.311	13.579	5.205			
1200	6.769	18.898	13.998	5.880			
1300	6.824	19.442	14.396	6.559			
1400	6.883	19.950	14.775	7.244			
1500	6.949	20.428	15.136	7.937			
1600	7.022	20.878	15.481	8.636			
1700	7.102	21.306	15.811	9.342			
1800	7.190	21.715	16.128	10.057			
1900	7.289	22.106	16.432	10.780			
2000	7.398	22.483	16.725	11.515			
2100	7.521	22.847	17.008	12.261			
2200	7.657	23.200	17.282	13.019			
2300	7.812	23.543	17.547	13.793			
2400	7.995	23.880	17.803	14.583			
2500	8.215	24.212	18.053	15.397			
2600	8.491	24.539	18.296	16.230			
2700	8.851	24.866	18.534	17.097			
2800	9.309	25.195	18.765	18.004			
2900	9.873	25.531	18.993	18.962			
3000	10.532	25.877	19.216	19.982			
3100	11.266	26.234	19.437	21.071			
3200	12.065	26.604	19.655	22.237			
3270	12.663	26.871	19.807	23.102			
3270	8.500	28.920	19.807	29.802			
3300	8.500	28.998	19.890	30.057			
3400	8.500	29.252	20.161	30.907			
3500	8.500	29.498	20.425	31.757			
3600	8.500	29.738	20.680	32.607			
3700	8.500	29.970	20.928	33.457			
3800	8.500	30.197	21.169	34.307			
3900	8.500	30.418	21.403	35.157			
4000	8.500	30.633	21.631	36.007			
4100	8.500	30.843	21.853	36.857			
4200	8.500	31.048	22.070	37.707			
4300	8.500	31.248	22.281	38.557			
4400	8.500	31.443	22.487	39.407			
4500	8.500	31.634	22.688	40.257			
4600	8.500	31.821	22.885	41.107			
4700	8.500	32.004	23.077	41.957			
4800	8.500	32.183	23.265	42.807			
4900	8.500	32.358	23.448	43.657			
5000	8.500	32.530	23.628	44.507			
5100	8.500	32.698	23.805	45.357			
5200	8.500	32.863	23.977	46.207			
5300	8.500	33.025	24.146	47.057			
5400	8.500	33.184	24.312	47.907			
5500	8.500	33.340	24.475	48.757			
5600	8.500	33.493	24.635	49.607			
5700	8.500	33.644	24.791	50.457			
5706.65	8.500	33.654	24.801	50.513			
5706.65	10.126	65.409	24.801	231.736			
5800	10.161	65.571	25.456	232.683			
5900	10.197	65.747	26.137	233.701			
6000	10.229	65.919	26.799	234.722			

15 March 1963

HLS

TANTALUM (Ta)

(REFERENCE STATE)

gfw = 180.95

0°K to 3270°K
 3270°K to 5706°K
 5706°K to 6000°K

Crystal
 Liquid
 Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 186.522 \text{ Kcal gfw}^{-1}$$

$$T_m = 3270^{\circ}\text{K}$$

$$T_B = 5706.65^{\circ}\text{K}$$

$$H_{298}^{\circ} - H_0^{\circ} = 1.358 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$S_{298.15}^{\circ} = 9.92 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$\Delta H_m = 6.700 \text{ Kcal gfw}^{-1}$$

$$\Delta H_v = 181.223 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 6.31 + 0.40 \times 10^{-3}T - 0.32 \times 10^{-5}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1} \quad 298.15 \leq T \leq 950^{\circ}\text{K}$$

C_p° = smoothed curve approximating data of Lehman¹, Taylor and Finch², and Rasor and McClelland³ for range 950° to 3270°K.

$$C_p^{\circ} = 8.5 \text{ cal degK}^{-1} \text{ gfw}^{-1} \text{ for liquid } (3270 \leq T \leq 5706^{\circ}\text{K}) \text{ (Estd.)}$$

Structure

Solid has B. C. C. A2 type structure, with no reported transitions to melting point.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low temperature data from Kelley⁴ and Sterrett and Wallace.⁵ High temperature data is from Kelley⁸ (298.15° to 950°K), and Lehman et al.^{1, 2, 3} for 950° to 3270°K. Liquid C_p° is estimated.

Melting

Several values were available. The value listed by Stull and Sinko⁶ was used. Heat of melting was an average of two estimates.

Heat of Sublimation

From Edwards, Johnston and Blackburn.⁷

References

1. Lehman, G. W., WADD TR 60-581 (1960).
2. Taylor, R. E. and R. A. Finch, NAA-SR-6034 (1961).
3. Rasor, N. and J. McClelland, WADC TR 56-400, AD118144 (1957).
4. Kelley, K. K., Bur. Mines, Bull. 592 (1961).
5. Sterrett, K. F. and W. E. Wallace, J. Am. Chem. Soc. 80, 3177 (1958).
6. Stull, D. R. and G. C. Sinko, Thermodynamic Properties of the Elements (1956).
7. Edwards, J. W., H. L. Johnston, and P. E. Blackburn, J. Am. Chem. Soc. 73, 172 (1951).
8. Kelley, K. K., Bur. Mines, Bull. 584 (1960).

TANTALUM (Ta)

(REFERENCE STATE)

GFW = 180.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K_p
298.15	± 0.050	± 0.040	± 0.040	± 0.000			
1000	± 0.100	± 0.103	± 0.065	± 0.038			
2000	± 0.500	± 0.345	± 0.136	± 0.418			
3000	± 1.000	± 0.639	± 0.249	± 1.168			
3270	± 1.000	± 0.725	± 0.285	± 1.438			
3270	± 2.000	± 1.031	± 0.285	± 2.438			
4000	± 2.000	± 1.434	± 0.439	± 3.898			
5000	± 2.000	± 1.880	± 0.700	± 5.898			

TABLE 234

TANTALUM

IDEAL MONATOMIC GAS

Ta

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ta from 0° to 3270°K,
Liquid Ta from 3270° to 5706°K, Gaseous Ta from 5706° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.482	186.398	186.398	INFINITE
298.15	4.985	44.243	44.243	0.000	186.522	176.289	-129.217
300	4.986	44.274	44.243	0.009	186.520	176.225	-128.374
400	5.081	45.719	44.440	0.512	186.404	172.810	-94.415
500	5.278	46.872	44.815	1.029	186.288	169.426	-74.052
600	5.541	47.857	45.241	1.570	186.187	166.063	-60.486
700	5.827	48.733	45.679	2.138	186.106	162.716	-50.800
800	6.110	49.530	46.111	2.735	186.047	159.379	-43.538
900	6.376	50.265	46.532	3.359	186.011	156.048	-37.892
1000	6.621	50.949	46.940	4.009	185.995	152.719	-33.375
1100	6.844	51.591	47.334	4.683	186.000	149.392	-29.680
1200	7.044	52.195	47.714	5.377	186.019	146.063	-26.600
1300	7.221	52.766	48.081	6.091	186.054	142.732	-23.994
1400	7.377	53.307	48.435	6.821	186.099	139.398	-21.760
1500	7.514	53.821	48.777	7.565	186.150	136.061	-19.823
1600	7.633	54.310	49.108	8.323	186.209	132.719	-18.128
1700	7.739	54.776	49.428	9.092	186.272	129.373	-16.631
1800	7.832	55.221	49.737	9.870	186.335	126.026	-15.301
1900	7.916	55.647	50.037	10.658	186.400	122.672	-14.110
2000	7.993	56.055	50.328	11.453	186.460	119.316	-13.038
2100	8.064	56.446	50.610	12.256	186.517	115.958	-12.067
2200	8.137	56.823	50.884	13.066	186.569	112.598	-11.185
2300	8.196	57.186	51.150	13.882	186.611	109.235	-10.379
2400	8.258	57.536	51.409	14.705	186.644	105.868	-9.640
2500	8.319	57.874	51.661	15.534	186.659	102.502	-8.960
2600	8.378	58.202	51.906	16.369	186.661	99.136	-8.333
2700	8.437	58.519	52.145	17.210	186.635	95.772	-7.752
2800	8.495	58.827	52.378	18.056	186.574	92.406	-7.212
2900	8.552	59.126	52.606	18.909	186.469	89.044	-6.710
3000	8.610	59.417	52.828	19.767	186.307	85.686	-6.242
3100	8.667	59.700	53.049	20.631	186.082	82.337	-5.804
3200	8.725	59.976	53.258	21.500	185.785	78.992	-5.395
3270	8.766	60.166	53.403	22.112	185.532	76.663	-5.124
3270	8.766	60.166	53.403	22.112	178.832	76.663	-5.124
3300	8.783	60.246	53.465	22.376	178.841	75.725	-5.015
3400	8.841	60.509	53.669	23.257	178.872	72.595	-4.666
3500	8.900	60.766	53.868	24.144	178.914	69.472	-4.338
3600	8.959	61.018	54.063	25.037	178.912	66.343	-4.027
3700	9.019	61.264	54.254	25.936	179.001	63.216	-3.734
3800	9.079	61.505	54.442	26.841	179.056	60.085	-3.455
3900	9.139	61.742	54.626	27.752	179.117	56.952	-3.191
4000	9.200	61.974	54.807	28.668	179.183	53.818	-2.940
4100	9.261	62.202	54.984	29.592	179.257	50.685	-2.702
4200	9.322	62.426	55.159	30.521	179.336	47.548	-2.474
4300	9.383	62.646	55.330	31.456	179.421	44.411	-2.257
4400	9.444	62.862	55.499	32.397	179.512	41.269	-2.050
4500	9.504	63.075	55.665	33.345	179.610	38.126	-1.852
4600	9.564	63.285	55.829	34.298	179.713	34.980	-1.662
4700	9.623	63.491	55.989	35.258	179.823	31.836	-1.480
4800	9.680	63.694	56.148	36.223	179.938	28.684	-1.306
4900	9.737	63.894	56.304	37.194	180.059	25.528	-1.139
5000	9.792	64.092	56.458	38.170	180.185	22.372	-0.978
5100	9.846	64.286	56.609	39.152	180.317	19.222	-0.824
5200	9.897	64.478	56.759	40.139	180.454	16.056	-0.675
5300	9.947	64.667	56.906	41.131	180.596	12.894	-0.532
5400	9.995	64.853	57.052	42.128	180.743	9.726	-0.394
5500	10.040	65.037	57.195	43.130	180.895	6.562	-0.261
5600	10.083	65.218	57.337	44.136	181.051	3.391	-0.132
5700	10.124	65.397	57.477	45.147	181.212	0.212	-0.008
5706.65	10.126	65.409	57.486	45.214	181.223	0.000	-0.000
5706.65	10.126	65.409	57.486	45.214	0.000	0.000	-0.000
5800	10.161	65.573	57.615	46.161			
5900	10.197	65.747	57.751	47.179			
6000	10.229	65.919	57.886	48.200			

15 March 1963

HLS

$$\Delta H_{f0}^{\circ} = 186.398 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $4F_{1/2}$

$$H_{298}^{\circ} - H_0^{\circ} = 1.482 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 186.522 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 44.243 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

All levels listed by Moore.¹

Heat of Formation

The data of Edwards, Johnston, and Blackburn² were used. Other data analyzed included that of Langmuir and Malter,³ Gebhardt, Seghezzi, and Keil,⁴ and Fiske.⁵

Heat Capacity and Entropy

Calculated using the monatomic gas program.

References

1. Moore, C., National Bureau of Standards (U.S.) Circular 467, Vol. 3 (1958).
2. Edwards, J. W., H. L. Johnston, P. E. Blackburn, J. Am. Chem. Soc. 73, 172 (1951).
3. Langmuir, D. and L. Malter, Phys. Rev. 55, 748 (1939).
4. Gebhardt, E., H. Seghezzi, and H. Keil, Z. Metallkunde 53, 524 (1962).
5. Fiske, R., Phys. Rev. 61, 513 (1942).

TANTALUM, MONATOMIC (Ta)

(IDEAL GAS)

GFW = 180.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 3.000		
1000	± 0.001	± 0.002	± 0.003	± 0.000			
2000	± 0.002	± 0.003	± 0.003	± 0.001			
3000	± 0.006	± 0.004	± 0.003	± 0.004			
4000	± 0.012	± 0.006	± 0.004	± 0.012			
5000	± 0.016	± 0.009	± 0.004	± 0.026			
5706.65	± 0.014	± 0.011	± 0.005	± 0.038			
6000	± 0.013	± 0.012	± 0.005	± 0.041			

TABLE 235

TECHNETIUM

REFERENCE STATE

Tc

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Tc from 0° to 2473°K,
Liquid Tc from 2473° to 4840°K, Gaseous Tc from 4840° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.230			
298.15	5.800	8.000	8.000	0.000			
300	5.804	8.036	8.000	0.011			
400	6.004	9.733	8.230	0.601			
500	6.204	11.094	8.671	1.212			
600	6.404	12.243	9.173	1.842			
700	6.604	13.245	9.685	2.492			
800	6.804	14.140	10.187	3.163			
900	7.004	14.953	10.672	3.853			
1000	7.204	15.701	11.138	4.564			
1100	7.404	16.397	11.585	5.294			
1200	7.604	17.050	12.013	6.044			
1300	7.804	17.667	12.425	6.815			
1400	8.004	18.252	12.820	7.605			
1500	8.204	18.811	13.201	8.416			
1600	8.404	19.347	13.569	9.246			
1700	8.604	19.863	13.924	10.096			
1800	8.804	20.360	14.268	10.967			
1900	9.004	20.842	14.601	11.857			
2000	9.204	21.309	14.925	12.768			
2100	9.404	21.762	15.240	13.698			
2200	9.604	22.204	15.546	14.648			
2300	9.804	22.636	15.845	15.619			
2400	10.004	23.057	16.137	16.609			
2473	10.150	23.359	16.346	17.345			
2473	10.000	25.659	16.346	23.033			
2500	10.000	25.768	16.447	23.303			
2600	10.000	26.160	16.813	24.303			
2700	10.000	26.537	17.166	25.303			
2800	10.000	26.901	17.507	26.303			
2900	10.000	27.252	17.837	27.303			
3000	10.000	27.591	18.157	28.303			
3100	10.000	27.919	18.466	29.303			
3200	10.000	28.236	18.767	30.303			
3300	10.000	28.544	19.058	31.303			
3400	10.000	28.843	19.342	32.303			
3500	10.000	29.133	19.618	33.303			
3600	10.000	29.414	19.886	34.303			
3700	10.000	29.688	20.147	35.303			
3800	10.000	29.955	20.402	36.303			
3900	10.000	30.215	20.650	37.303			
4000	10.000	30.468	20.892	38.303			
4100	10.000	30.715	21.129	39.303			
4200	10.000	30.956	21.360	40.303			
4300	10.000	31.191	21.586	41.303			
4400	10.000	31.421	21.807	42.303			
4500	10.000	31.646	22.023	43.303			
4600	10.000	31.866	22.234	44.303			
4700	10.000	32.081	22.442	45.303			
4800	10.000	32.291	22.645	46.303			
4840.07	10.000	32.374	22.724	46.704			
4840.07	7.499	61.273	22.724	186.575			
4900	7.527	61.386	23.198	187.024			
5000	7.559	61.518	23.962	187.778			
5100	7.594	61.668	24.700	188.536			
5200	7.628	61.816	25.413	189.297			
5300	7.660	61.961	26.100	190.061			
5400	7.691	62.105	26.766	190.829			
5500	7.720	62.246	27.410	191.600			
5600	7.748	62.386	28.034	192.373			
5700	7.774	62.523	28.637	193.149			
5800	7.798	62.658	29.222	193.928			
5900	7.821	62.792	29.790	194.709			
6000	7.842	62.923	30.341	195.492			

15 December 1962

RCF

TECHNETIUM (Tc)

(REFERENCE STATE)

gfw = 99*

0°K to 2473°K
2473°K to 4840°K
4840°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 155.000 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 8.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_m = 2473^{\circ}\text{K}$$

$$\Delta H_m = 5.688 \text{ kcal gfw}^{-1}$$

$$T_b = 4840^{\circ}\text{K}$$

$$\Delta H_v = 139.871 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.230 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.200 + 2.000 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$298.15^{\circ}\text{K} \leq T \leq 2473^{\circ}\text{K}$$

$$C_p^{\circ} = 10.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2473^{\circ}\text{K} \leq T \leq 4840^{\circ}\text{K}$$

Structure

An h. c. p. (A3) type.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Brewer's¹ estimate of S_{298}° adopted. Kelley's² high-temperature heat-capacity data adopted. Based on Brewer's¹ heat-content estimates. Liquid heat capacity estimated.

Melting and Vaporization

Heat of fusion estimated. Vapor-pressure data of Brewer¹ used in calculating b. p. Heat of vaporization calculated.

References

1. Brewer, L., Paper 3, Chemistry and Metallurgy of Miscellaneous Materials: Thermodynamics, Nat. Nucl. Energ. Ser. IV-19B, McGraw-Hill, N. Y. (1950).
2. Kelley, K. K., U. S. Bur. Mines, Bull. 584 (1960).

*

Isotope of longest known half-life.

TECHNETIUM (Tc)

(REFERENCE STATE)

GFW = 99

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f	ΔF_f	log K _p
298.15	± 0.100	± 0.300	± 0.500	± 0.000			
1000	± 0.500	± 0.740	± 0.600	± 0.140			
2000	± 1.000	± 1.260	± 0.600	± 0.890			
2473	± 1.250	± 1.500	± 0.810	± 1.420			
2473	± 0.500	± 1.900	± 0.920	± 2.420			
3000	± 1.550	± 2.100	± 0.920	± 2.960			
4000	± 3.550	± 2.830	± 1.110	± 4.510			
4840.07	± 5.230	± 3.670	± 1.700	± 8.200			
4840.07	± 0.001	± 0.003	± 0.003	± 0.002			
5000	± 0.001	± 0.003	± 0.003	± 0.002			
6000	± 0.001	± 0.003	± 0.003	± 0.003			

TABLE 236

TECHNETIUM

IDEAL MONATOMIC GAS

Tc

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Tc from 0° to 2473°K,
Liquid Tc from 2473° to 4840°K, Gaseous Tc from 4840° to 6000°K.

T, °K	C_p°	$\frac{\text{cal}}{^\circ\text{K gfw}}$ S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	154.747	154.747	INFINITE
298.15	4.970	43.250	43.250	0.000	155.000	144.420	-105.204
300	4.970	43.280	43.250	0.000	154.998	144.425	-105.208
400	4.997	44.713	43.465	0.507	154.976	140.214	-76.288
500	5.106	45.848	43.815	1.012	154.800	137.428	-60.067
600	5.328	46.767	44.233	1.532	154.690	133.964	-44.794
700	5.660	47.612	44.659	2.081	154.587	130.514	-30.748
800	6.060	48.413	45.080	2.667	154.504	127.066	-18.717
900	6.477	49.151	45.492	3.294	154.441	123.662	-9.028
1000	6.863	49.844	45.893	3.961	154.397	120.245	-2.278
1100	7.184	50.524	46.284	4.664	154.370	116.831	23.211
1200	7.424	51.160	46.664	5.395	154.351	113.417	20.655
1300	7.581	51.761	47.033	6.146	154.331	110.010	18.493
1400	7.663	52.326	47.391	6.907	154.304	106.601	16.640
1500	7.683	52.856	47.738	7.677	154.261	103.194	15.035
1600	7.657	53.351	48.074	8.444	154.198	99.772	13.630
1700	7.597	53.814	48.398	9.207	154.111	96.344	12.332
1800	7.517	54.246	48.711	9.963	153.996	92.903	11.292
1900	7.426	54.650	49.013	10.710	153.853	89.517	10.308
2000	7.332	55.028	49.304	11.448	153.680	86.242	9.424
2100	7.241	55.384	49.585	12.176	153.478	82.976	8.625
2200	7.156	55.711	49.857	12.896	153.248	79.716	7.892
2300	7.069	56.035	50.118	13.608	152.989	76.472	7.238
2400	7.015	56.355	50.371	14.313	152.704	72.848	6.632
2473	6.974	56.443	50.442	14.423	152.672	70.416	6.223
2500	6.974	56.443	50.442	14.423	146.770	70.416	6.223
2600	6.961	56.620	50.615	15.011	146.708	69.580	6.082
2700	6.918	56.812	50.812	15.705	146.402	66.499	5.590
2800	6.847	57.113	51.087	16.395	146.097	63.432	5.134
2900	6.866	57.407	51.302	17.083	145.780	60.374	4.712
3000	6.856	57.693	51.516	17.769	145.466	57.331	4.320
3100	6.854	57.976	51.724	18.454	145.151	54.299	3.955
3200	6.860	58.251	51.926	19.140	144.837	51.274	3.615
3300	6.874	58.517	52.123	19.827	144.524	48.261	3.296
3400	6.894	58.770	52.314	20.515	144.212	45.255	2.997
3500	6.920	59.017	52.500	21.206	143.900	42.263	2.717
3600	6.950	59.258	52.681	21.899	143.597	39.280	2.453
3700	6.984	59.494	52.857	22.596	143.294	36.304	2.204
3800	7.021	59.726	53.028	23.296	142.993	33.333	1.969
3900	7.061	59.953	53.198	24.000	142.697	30.375	1.747
4000	7.102	60.177	53.362	24.708	142.405	27.423	1.537
4100	7.144	60.398	53.521	25.420	142.117	24.476	1.337
4200	7.188	60.615	53.675	26.137	141.834	21.541	1.146
4300	7.231	60.828	53.824	26.858	141.551	18.609	0.968
4400	7.275	61.036	53.968	27.583	141.267	15.680	0.797
4500	7.318	61.240	54.107	28.313	140.980	12.770	0.634
4600	7.361	61.442	54.242	29.047	140.744	9.857	0.477
4700	7.403	61.644	54.372	29.785	140.482	6.947	0.330
4800	7.444	61.844	54.508	30.528	140.221	4.035	0.189
4840.07	7.484	61.941	54.605	31.274	139.971	1.160	0.053
4840.07	7.484	61.941	54.605	31.274	137.871	0.000	0.000
4900	7.497	61.941	54.605	31.274	137.871	0.000	0.000
5000	7.522	61.941	54.605	31.274	137.871	0.000	0.000
5100	7.554	61.941	54.605	31.274	137.871	0.000	0.000
5200	7.594	61.668	54.292	33.536	141.551	18.609	0.968
5300	7.628	61.316	53.920	34.297	141.267	15.680	0.797
5400	7.660	61.061	53.546	35.061	141.000	12.770	0.634
5500	7.691	62.105	54.477	35.829	140.744	9.857	0.477
5600	7.723	62.246	54.542	36.600	140.482	6.947	0.330
5700	7.748	62.386	54.712	37.373	140.221	4.035	0.189
5800	7.774	62.523	54.880	38.149	140.000	1.160	0.053
5900	7.798	62.658	55.047	38.928	139.771	0.000	0.000
6000	7.821	62.793	55.215	39.700	139.544	0.000	0.000

15 December 1962

RCF

$$\Delta H_{f0}^{\circ} = 154.749 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 155.000 \text{ kcal gfw}^{-1}$$

$$\text{Ground State Configuration} = 6S_{2\frac{1}{2}}$$

$$S_{298.15}^{\circ} = 43.250 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and Multiplicities

Spectroscopic energy levels from Moore.¹

Heat of Formation

Estimate of Stull and Sinke² adopted. Based on vapor-pressure estimates of Brewer.³

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

References

1. Moore, C., Nat. Bur. Stds. (U. S.) Circ. 467, Vol. 3 (May 1958).
2. Stull, D. R. and G. C. Sinke, Advances in Chemistry, Ser. 18, Am. Chem. Soc., Washington, D. C. (1956).
3. Brewer, L., Paper 3, Chemistry and Metallurgy of Miscellaneous Materials: Thermodynamics, Natl. Nucl. Energ. Ser. IV-19B, McGraw-Hill, N. Y. (1950).

*

Isotope of longest known half-life.

TECHNETIUM, MONATOMIC (Tc)

(IDEAL GAS)

GFW = 99

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 5.000	± 5.150	± 3.770
1000	± 0.001	± 0.002	± 0.002	± 0.000	± 5.140	± 5.600	± 1.220
2000	± 0.001	± 0.003	± 0.003	± 0.001	± 5.890	± 6.630	± 0.720
2473	± 0.001	± 0.003	± 0.003	± 0.001	± 6.420	± 7.280	± 0.640
2473	± 0.001	± 0.003	± 0.003	± 0.001	± 7.420	± 7.280	± 0.640
3000	± 0.001	± 0.003	± 0.003	± 0.001	± 7.960	± 8.340	± 0.610
4000	± 0.001	± 0.003	± 0.003	± 0.002	± 9.510	± 11.810	± 0.650
4840.07	± 0.001	± 0.003	± 0.003	± 0.002	± 13.200	± 14.600	± 0.660
4840.07	± 0.001	± 0.003	± 0.003	± 0.002			
5000	± 0.001	± 0.003	± 0.003	± 0.002			
6000	± 0.001	± 0.003	± 0.003	± 0.003			

TABLE 237

THORIUM

REFERENCE STATE

Th

Reference State for Calculating ΔH_f° , ΔF_f° , and Log Kp: Solid Th from 0° to 2028°K,
Liquid Th from 2028° to 5060°K, Gaseous Th from 5060° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	Log Kp
0	0.000	0.000	INFINITE	-1.556			
298.15	6.532	12.760	12.760	0.000			
300	6.537	12.800	12.760	0.012			
400	6.792	14.716	13.020	0.679			
500	7.047	16.259	13.518	1.370			
600	7.302	17.566	14.086	2.088			
700	7.557	18.711	14.667	2.831			
800	7.812	19.737	15.238	3.599			
900	8.067	20.671	15.790	4.393			
1000	8.368	21.536	16.322	5.214			
1100	8.730	22.350	16.833	6.068			
1200	9.170	23.128	17.325	6.963			
1300	9.702	23.882	17.801	7.906			
1400	10.341	24.624	18.262	8.907			
1500	11.104	25.362	18.710	9.978			
1600	12.001	26.107	19.150	11.132			
1633	12.338	26.356	19.293	11.533			
1633	11.000	26.756	19.293	12.186			
1700	11.000	27.198	19.596	12.923			
1800	11.000	27.827	20.036	14.023			
1900	11.000	28.422	20.462	15.123			
2000	11.000	28.986	20.874	16.223			
2028	11.000	29.139	20.987	16.531			
2028	11.000	31.039	20.987	20.384			
2100	11.000	31.422	21.339	21.176			
2200	11.000	31.934	21.809	22.276			
2300	11.000	32.423	22.260	23.376			
2400	11.000	32.891	22.693	24.476			
2500	11.000	33.340	23.110	25.576			
2600	11.000	33.772	23.512	26.676			
2700	11.000	34.187	23.899	27.776			
2800	11.000	34.587	24.274	28.876			
2900	11.000	34.973	24.636	29.976			
3000	11.000	35.346	24.987	31.076			
3100	11.000	35.707	25.327	32.176			
3200	11.000	36.056	25.657	33.276			
3300	11.000	36.394	25.977	34.376			
3400	11.000	36.723	26.289	35.476			
3500	11.000	37.042	26.591	36.576			
3600	11.000	37.351	26.886	37.676			
3700	11.000	37.653	27.173	38.776			
3800	11.000	37.946	27.452	39.876			
3900	11.000	38.232	27.725	40.976			
4000	11.000	38.510	27.991	42.076			
4100	11.000	38.782	28.251	43.176			
4200	11.000	39.047	28.505	44.276			
4300	11.000	39.306	28.753	45.376			
4400	11.000	39.559	28.996	46.476			
4500	11.000	39.806	29.234	47.576			
4600	11.000	40.048	29.466	48.676			
4700	11.000	40.284	29.693	49.776			
4800	11.000	40.516	29.917	50.876			
4900	11.000	40.743	30.136	51.976			
5000	11.000	40.965	30.350	53.076			
5060.26	11.000	41.097	30.477	53.739			
5060.26	9.340	65.357	30.477	176.504			
5100	9.356	65.430	30.749	176.875			
5200	9.394	65.617	31.417	177.812			
5300	9.430	65.792	32.065	178.753			
5400	9.464	65.968	32.691	179.698			
5500	9.496	66.142	33.297	180.646			
5600	9.525	66.314	33.886	181.597			
5700	9.552	66.482	34.456	182.551			
5800	9.575	66.649	35.010	183.507			
5900	9.596	66.813	35.548	184.466			
6000	9.613	66.974	36.070	185.426			

15 December 1962

RCF

THORIUM (Th)

(REFERENCE STATE)

gfw = 232.05

0°K to 2028°K
2028°K to 5060°K
5060°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 137.700 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 12.760 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$T_l = 1633^{\circ}\text{K}$$

$$\Delta H_l = 0.653 \text{ kcal gfw}^{-1}$$

$$T_m = 2028^{\circ}\text{K}$$

$$\Delta H_m = 3.853 \text{ kcal gfw}^{-1}$$

$$T_b = 5060^{\circ}\text{K}$$

$$\Delta H_v = 122.765 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.556 \text{ kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.773 + 2.548 \times 10^{-3} T \text{ cal deg K}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 800^{\circ}\text{K}$$

$$C_p^{\circ} = 5.553 + 4.928 \times 10^{-3} T - 4.703 \times 10^{-6} T^2 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$800^{\circ}\text{K} \leq T \leq 1633^{\circ}\text{K}$$

$$C_p^{\circ} = 11.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$1633^{\circ}\text{K} \leq T \leq 2028^{\circ}\text{K}$$

$$C_p^{\circ} = 11.000 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$2028^{\circ}\text{K} \leq T \leq 5060^{\circ}\text{K}$$

Structure

Two modifications f. c. c. (A1) and b. c. c. (A2) type.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature data from Griffel and Shochdopole.¹ Wallace's² high-temperature heat-capacity data joined smoothly to low-temperature data. Liquid heat capacity estimated.

Melting and Vaporization

Heat of fusion taken from estimate of Stull and Sinke.³ Vapor-pressure data of Darnell *et al.*⁴ adopted. See volume 1, this study (section IVA29) for details.

References

1. Griffel, M. and R. E. Shochdopole, J. Am. Chem. Soc. 75, 5250 (1953).
2. Wallace, D., Phys. Rev. 120, 84 (1956).
3. Stull, D. R. and G. C. Sinke, *Advances in Chemistry*, Ser. 18, Am. Chem. Soc., Washington, D. C. (1956).
4. Darnell, A. J., W. A. McCollum, and T. A. Milne, J. Phys. Chem. 64, 341 (1960).

THORIUM (Th)

(REFERENCE STATE)

GFW = 232.05

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _l	ΔF _l	
298.15	± 0.050	± 0.200	± 0.200	± 0.000			
1000	± 0.150	± 0.260	± 0.220	± 0.040			
1633	± 0.250	± 0.360	± 0.260	± 0.160			
1633	± 1.000	± 0.480	± 0.260	± 0.360			
2028	± 1.000	± 0.700	± 0.320	± 0.760			
2028	± 0.600	± 1.190	± 0.320	± 1.760			
3000	± 2.800	± 1.860	± 0.720	± 3.410			
4000	± 5.000	± 2.980	± 1.150	± 7.310			
5060.26	± 7.300	± 4.420	± 1.690	± 13.830			
5060.26	± 0.500	± 0.465	± 0.220	± 1.230			
6000	± 0.600	± 0.575	± 0.280	± 1.780			

TABLE 238

THORIUM

IDEAL MONATOMIC GAS

Th

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Th from 0° to 2028°K,
Liquid Th from 2028° to 5060°K, Gaseous Th from 5060° to 6000°K.

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.481	137.775	137.775	INFINITE
298.15	4.969	45.426	45.426	0.000	137.700	127.961	-93.793
300	4.969	45.457	45.426	0.009	137.697	127.900	-93.171
400	4.982	46.888	45.621	0.506	137.527	124.660	-68.108
500	5.039	48.004	45.990	1.007	137.337	121.464	-53.089
600	5.171	48.934	46.405	1.517	137.129	118.309	-43.092
700	5.388	49.746	46.826	2.044	136.913	115.189	-35.962
800	5.679	50.484	47.237	2.597	136.698	112.101	-30.623
900	6.022	51.172	47.637	3.182	136.489	109.038	-26.477
1000	6.390	51.825	48.023	3.802	136.288	105.999	-23.165
1100	6.761	52.452	48.398	4.460	136.092	102.978	-20.459
1200	7.116	53.056	48.761	5.154	135.891	99.977	-18.207
1300	7.441	53.638	49.114	5.882	135.676	96.993	-16.305
1400	7.729	54.201	49.457	6.641	135.434	94.027	-14.678
1500	7.975	54.742	49.791	7.426	135.148	91.078	-13.269
1600	8.180	55.264	50.117	8.235	134.803	88.153	-12.041
1633	8.240	55.432	50.222	8.508	134.675	87.193	-11.669
1633	8.240	55.432	50.222	8.508	134.675	87.193	-11.669
1700	8.346	55.765	50.435	9.061	133.838	85.274	-10.962
1800	8.476	56.246	50.744	9.903	133.580	82.426	-10.007
1900	8.574	56.707	51.046	10.755	133.332	79.590	-9.155
2000	8.646	57.149	51.340	11.616	133.093	76.768	-8.388
2028	8.661	57.268	51.420	11.859	133.028	75.982	-8.188
2028	8.661	57.268	51.420	11.859	129.175	75.982	-8.188
2100	8.695	57.572	51.627	12.484	129.008	74.095	-7.711
2200	8.727	57.977	51.907	13.355	128.779	71.484	-7.101
2300	8.745	58.365	52.179	14.229	128.553	68.886	-6.545
2400	8.754	58.738	52.445	15.104	128.328	66.295	-6.037
2500	8.755	59.095	52.703	15.979	128.103	63.718	-5.570
2600	8.751	59.438	52.956	16.854	127.878	61.146	-5.140
2700	8.746	59.769	53.202	17.729	127.653	58.582	-4.742
2800	8.740	60.087	53.442	18.604	127.428	56.030	-4.373
2900	8.735	60.393	53.677	19.477	127.201	53.481	-4.030
3000	8.732	60.687	53.906	20.351	126.975	50.943	-3.711
3100	8.732	60.976	54.129	21.224	126.748	48.414	-3.413
3200	8.735	61.253	54.347	22.097	126.521	45.892	-3.134
3300	8.742	61.522	54.561	22.971	126.295	43.373	-2.872
3400	8.754	61.783	54.769	23.846	126.070	40.868	-2.627
3500	8.769	62.037	54.973	24.722	125.846	38.363	-2.395
3600	8.789	62.284	55.173	25.600	125.624	35.867	-2.177
3700	8.812	62.525	55.369	26.480	125.404	33.375	-1.971
3800	8.839	62.761	55.560	27.362	125.186	30.890	-1.776
3900	8.870	62.991	55.748	28.247	124.971	28.410	-1.592
4000	8.903	63.216	55.931	29.136	124.760	25.940	-1.417
4100	8.940	63.436	56.112	30.028	124.552	23.470	-1.251
4200	8.978	63.652	56.289	30.924	124.348	21.007	-1.093
4300	9.018	63.863	56.462	31.824	124.148	18.551	-0.943
4400	9.060	64.071	56.633	32.728	123.952	16.097	-0.799
4500	9.103	64.275	56.801	33.636	123.760	13.648	-0.663
4600	9.146	64.476	56.965	34.548	123.572	11.205	-0.532
4700	9.189	64.673	57.127	35.465	123.389	8.760	-0.407
4800	9.232	64.867	57.286	36.386	123.210	6.329	-0.288
4900	9.275	65.058	57.443	37.312	123.036	3.896	-0.174
5000	9.316	65.245	57.597	38.241	122.865	1.465	-0.064
5060.26	9.340	65.357	57.689	38.804	122.765	0.000	0.000
5060.26	9.340	65.357	57.689	38.804			
5100	9.356	65.430	57.749	39.175			
5200	9.394	65.612	57.899	40.112			
5300	9.430	65.792	58.046	41.053			
5400	9.464	65.968	58.191	41.998			
5500	9.496	66.142	58.334	42.946			
5600	9.525	66.314	58.475	43.897			
5700	9.552	66.482	58.614	44.851			
5800	9.575	66.649	58.751	45.807			
5900	9.596	66.813	58.886	46.766			
6000	9.613	66.974	59.020	47.726			

15 December 1962

RCF

THORIUM (Th)

(IDEAL MONATOMIC GAS)

gfw = 232.05

$$\Delta H_{f0}^{\circ} = 137.775 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 137.700 \text{ kcal gfw}^{-1}$$

Ground State Configuration = 3F_2

$$S_{298.15}^{\circ} = 45.426 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.481 \text{ kcal gfw}^{-1}$$

Electronic Levels and MultiplicitiesSpectroscopic energy levels from Zalubas.¹Heat of Formation

Vapor-pressure data from Darnell et al.² ΔH_{298}° derived from a Third Law calculation.

Heat Capacity and Entropy

Calculated from the monatomic-gas computer program. See volume 1, this study (section IVA29) for details.

References

1. Zalubas, R., J. Res. Natl. Bur. Stds. (U.S.) 63A, 275 (1959).
2. Darnell, A. J., W. A. McCollum, and T. A. Milne, J. Phys. Chem. 64, 341 (1960).

THORIUM, MONATOMIC (Th)

(IDEAL GAS)

GFW = 232.05

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f	
298.15	± 0.010	± 0.005	± 0.005	± 0.000	± 1.000	± 1.060	± 0.780
1000	± 0.100	± 0.059	± 0.027	± 0.032	± 1.070	± 1.250	± 0.270
1633	± 0.160	± 0.120	± 0.050	± 0.120	± 0.280	± 1.510	± 0.200
1633	± 0.160	± 0.120	± 0.050	± 0.120	± 0.480	± 1.510	± 0.200
2028	± 0.200	± 0.160	± 0.070	± 0.180	± 0.940	± 1.790	± 0.190
2028	± 0.200	± 0.160	± 0.070	± 0.180	± 1.940	± 1.790	± 0.190
3000	± 0.300	± 0.260	± 0.120	± 0.430	± 3.840	± 3.520	± 0.260
4000	± 0.400	± 0.365	± 0.170	± 0.780	± 8.090	± 6.280	± 0.340
5060.26	± 0.500	± 0.465	± 0.220	± 1.230	± 15.060	± 10.660	± 0.460
5060.26	± 0.500	± 0.465	± 0.220	± 1.230			
6000	± 0.600	± 0.575	± 0.280	± 1.780			

TABLE 239

TITANIUM

REFERENCE STATE

Ti

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.150			
298.15	5.970	7.330	7.330	0.000			
300	5.980	7.367	7.330	0.011			
400	6.360	9.147	7.570	0.631			
500	6.620	10.595	8.035	1.280			
600	6.840	11.822	8.566	1.953			
700	7.020	12.890	9.109	2.647			
800	7.180	13.838	9.642	3.357			
900	7.330	14.693	10.157	4.082			
1000	7.470	15.472	10.650	4.822			
1100	7.600	16.190	11.121	5.576			
1155	7.667	16.563	11.372	5.996			
1155	7.667	17.385	11.372	6.946			
1200	7.720	17.679	11.603	7.292			
1300	7.840	18.302	12.094	8.070			
1400	7.950	18.887	12.559	8.860			
1500	8.060	19.439	12.999	9.660			
1600	8.160	19.963	13.418	10.471			
1700	8.260	20.460	13.818	11.292			
1800	8.360	20.935	14.200	12.123			
1900	8.460	21.390	14.567	12.964			
1950	8.510	21.610	14.745	13.388			
1950	8.000	23.507	14.745	17.088			
2000	8.000	23.710	14.966	17.489			
2100	8.000	24.101	15.392	18.289			
2200	8.000	24.473	15.796	19.089			
2300	8.000	24.829	16.181	19.889			
2400	8.000	25.169	16.549	20.689			
2500	8.000	25.496	16.900	21.489			
2600	8.000	25.809	17.237	22.289			
2700	8.000	26.111	17.560	23.089			
2800	8.000	26.402	17.871	23.889			
2900	8.000	26.683	18.170	24.689			
3000	8.000	26.954	18.458	25.489			
3100	8.000	27.217	18.736	26.289			
3200	8.000	27.470	19.005	27.089			
3300	8.000	27.717	19.266	27.889			
3400	8.000	27.955	19.518	28.689			
3500	8.000	28.187	19.762	29.489			
3550	8.000	28.303	19.881	29.889			
3550	8.068	57.162	19.881	132.346			
3600	8.137	57.275	20.400	132.751			
3700	8.274	57.500	21.400	133.571			
3800	8.408	57.723	22.353	134.405			
3900	8.539	57.943	23.262	135.253			
4000	8.666	58.160	24.132	136.113			
4100	8.790	58.376	24.965	136.986			
4200	8.910	58.589	25.763	137.871			
4300	9.026	58.800	26.529	138.768			
4400	9.137	59.009	27.265	139.676			
4500	9.244	59.216	27.972	140.595			
4600	9.346	59.420	28.654	141.524			
4700	9.443	59.622	29.310	142.464			
4800	9.535	59.822	29.944	143.413			
4900	9.623	60.019	30.556	144.371			
5000	9.706	60.214	31.147	145.337			
5100	9.784	60.407	31.719	146.312			
5200	9.857	60.598	32.272	147.294			
5300	9.926	60.787	32.809	148.283			
5400	9.990	60.973	33.328	149.279			
5500	10.050	61.157	33.833	150.281			
5600	10.105	61.338	34.322	151.289			
5700	10.155	61.517	34.798	152.302			
5800	10.202	61.694	35.260	153.320			
5900	10.245	61.869	35.710	154.342			
6000	10.284	62.042	36.147	155.368			

May 1962

HLS

TITANIUM (Ti)

(REFERENCE STATE)

gfw = 47.90

0 °K to 1950 °K Crystal

1950 °K to 3550 °K Liquid

3550 °K to 6000 °K Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{s298.15}^{\circ} = 112.490 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 7.330 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_t = 1155 \text{ °K}$$

$$\Delta H_t = 0.950 \text{ Kcal gfw}^{-1}$$

$$T_m = 1950 \text{ °K}$$

$$\Delta H_m = 3.700 \text{ Kcal gfw}^{-1}$$

$$T_b = 3550 \text{ °K}$$

$$\Delta H_v = 102.458 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.150 \text{ Kcal gfw}^{-1}$$

Structure

Low temperature form (α - Ti) is h. c. p. ; high temperature form (β - Ti) is b. c. c.

Heat of Formation

Zero by definition

Heat Capacity and Entropy

JANAF¹ tables results were accepted for this table.

Melting

Five values agreed with JANAF¹.

Vaporization

Three determinations had been made. Further details are given by Barriault *et al*².

References

1. JANAF Thermochemical Tables, Dow Chemical Co., Midland Mich. (1960).
2. Barriault, R., *et al*, ASD TR-61-260 (May 1962), Pt. I.

TITANIUM (Ti)

(REFERENCE STATE)

GFW = 47.90

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.050	±0.020	±0.020	±0.000			
1000	±0.500	±0.346	±0.157	±0.189			
1155	±0.500	±0.418	±0.188	±0.266			
1155	±0.500	±0.504	±0.188	±0.366			
1950	±1.000	±0.896	±0.403	±0.962			
1950	±1.000	±1.152	±0.403	±1.462			
2000	±1.000	±1.177	±0.421	±1.512			
3000	±2.000	±1.785	±0.781	±3.012			
3550	±2.000	±2.121	±0.963	±4.112			
3550	±2.000	±0.003	±0.284	±1.002			
4000	±0.002	±0.003	±0.253	±1.002			
5000	±0.005	±0.003	±0.203	±1.003			
6000	±0.010	±0.003	±0.170	±1.004			

TABLE 240

TITANIUM

IDEAL MONATOMIC GAS

Ti

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Ti from 0° to 1950°K,
Liquid Ti from 1950° to 3550°K, Gaseous Ti from 3550° to 6000°K.

T, °K	C_p	C_p	$-(H_T - H_{298}^\circ)/T$	$H_T - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.802	111.838	111.838	INFINITE
298.15	5.838	43.068	43.068	0.000	112.490	101.835	-74.643
300	5.831	43.104	43.068	0.011	112.490	101.769	-74.135
400	5.522	44.735	43.293	0.577	112.436	98.201	-53.652
500	5.344	45.946	43.707	1.120	112.330	94.654	-41.371
600	5.237	46.911	44.164	1.648	112.185	91.132	-33.193
700	5.170	47.712	44.615	2.168	112.011	87.636	-27.360
800	5.128	48.400	45.046	2.683	111.816	84.167	-22.992
900	5.104	49.002	45.453	3.194	111.602	80.724	-19.602
1000	5.095	49.539	45.835	3.704	111.372	77.305	-16.894
1100	5.106	50.025	46.194	4.214	111.128	73.909	-14.684
1155	5.118	50.275	46.383	4.496	110.990	72.052	-13.633
1200	5.118	50.275	46.383	4.496	110.040	72.052	-13.633
1250	5.132	50.471	46.532	4.726	109.974	70.574	-12.853
1300	5.176	50.883	46.851	5.241	109.661	67.306	-11.315
1400	5.237	51.269	47.153	5.762	109.392	64.057	-9.999
1500	5.313	51.633	47.440	6.289	109.119	60.829	-8.862
1600	5.403	51.978	47.713	6.825	108.844	57.619	-7.870
1700	5.506	52.309	47.974	7.370	108.568	54.425	-6.996
1800	5.616	52.627	48.223	7.926	108.293	51.248	-6.222
1900	5.736	52.934	48.463	8.494	108.020	48.087	-5.531
1950	5.799	53.084	48.580	8.782	107.884	46.512	-5.213
1950	5.799	53.084	48.580	8.782	104.184	46.512	-5.213
2000	5.863	53.231	48.694	9.074	104.075	45.033	-4.921
2100	5.995	53.520	48.917	9.667	103.868	42.087	-4.380
2200	6.131	53.802	49.133	10.273	103.674	39.150	-3.889
2300	6.269	54.078	49.342	10.893	103.494	36.222	-3.442
2400	6.411	54.348	49.545	11.527	103.328	33.299	-3.032
2500	6.553	54.612	49.742	12.175	103.176	30.386	-2.656
2600	6.698	54.872	49.934	12.837	103.038	27.475	-2.309
2700	6.843	55.127	50.122	13.514	102.915	24.571	-1.989
2800	6.988	55.379	50.305	14.206	102.807	21.672	-1.691
2900	7.134	55.627	50.485	14.912	102.713	18.776	-1.415
3000	7.281	55.871	50.660	15.633	102.634	15.883	-1.157
3100	7.427	56.112	50.832	16.368	102.569	12.994	-0.916
3200	7.571	56.350	51.001	17.118	102.519	10.102	-0.690
3300	7.715	56.585	51.166	17.882	102.483	7.218	-0.478
3400	7.857	56.818	51.329	18.661	102.452	4.328	-0.278
3500	7.998	57.048	51.489	19.454	102.425	1.443	-0.090
3550	8.068	57.162	51.569	19.856	102.458	0.009	0.001
3550	8.068	57.162	51.569	19.856			
3600	8.137	57.275	51.647	20.261			
3700	8.274	57.500	51.802	21.081			
3800	8.408	57.722	51.955	21.915			
3900	8.539	57.942	52.106	22.763			
4000	8.666	58.160	52.254	23.623			
4100	8.790	58.376	52.401	24.496			
4200	8.910	58.589	52.546	25.381			
4300	9.026	58.800	52.689	26.277			
4400	9.137	59.009	52.830	27.186			
4500	9.244	59.215	52.970	28.105			
4600	9.346	59.419	53.108	29.034			
4700	9.443	59.621	53.244	29.974			
4800	9.535	59.821	53.379	30.923			
4900	9.623	60.019	53.513	31.881			
5000	9.706	60.214	53.645	32.847			
5100	9.784	60.407	53.775	33.822			
5200	9.857	60.598	53.905	34.804			
5300	9.926	60.786	54.033	35.793			
5400	9.990	60.972	54.160	36.789			
5500	10.050	61.156	54.285	37.791			
5600	10.105	61.338	54.509	38.798			
5700	10.156	61.517	54.533	39.812			
5800	10.202	61.694	54.654	40.829			
5900	10.245	61.869	54.775	41.852			
6000	10.284	62.041	54.895	42.878			

May 1962

HLS

TITANIUM, MONATOMIC (Ti) (IDEAL GAS)

gfw = 47.90

$$\Delta H_{f0}^{\circ} = 111.838 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 112.490 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $3F_2$

$$S_{298.15}^{\circ} = 43.068 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.802 \text{ Kcal gfw}^{-1}$$

Electronic levels and multiplicities

Atomic energy levels from Moore¹.

Heat of Formation

Based on three vaporization determinations.

Heat Capacity and Entropy

A table had been calculated using the data from the present project.² It agreed well with JANAF³. In the interest of consistency, the latter data were accepted.

References

1. Moore, C., Atomic Energy Levels Vol. 1 Nat. Bur. Stds. (1949).
2. Barriault, R., et al, ASD TR-61-260 (May 1962), Pt. I.
3. JANAF Thermochemical Tables, Dow Chemical Co. (1960).

TITANIUM, MONATOMIC (Ti)

(IDEAL GAS)

GFW = 47.90

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	±0.000	±0.002	±0.003	±0.000	±1.000	±1.007	±0.738
1000	±0.001	±0.002	±0.003	±0.001	±1.190	±1.160	±0.253
1155	±0.001	±0.002	±0.003	±0.001	±1.267	±1.220	±0.230
1155	±0.001	±0.002	±0.003	±0.001	±1.367	±1.220	±0.230
1950	±0.001	±0.002	±0.003	±0.001	±1.963	±1.791	±0.200
1950	±0.001	±0.002	±0.003	±0.001	±2.463	±1.791	±0.200
2000	±0.001	±0.002	±0.003	±0.001	±2.513	±1.848	±0.201
3000	±0.001	±0.003	±0.003	±0.002	±4.014	±3.352	±0.244
3550	±0.002	±0.003	±0.003	±0.002	±5.114	±4.429	±0.272
3550	±0.002	±0.003	±0.003	±0.002			
4000	±0.002	±0.003	±0.002	±0.002			
5000	±0.003	±0.003	±0.003	±0.003			
6000	±0.010	±0.003	±0.004	±0.004			

TABLE 241

URANIUM

REFERENCE STATE

U

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid U from 0° to 1406°K,
Liquid U from 1406° to 4124°K, Gaseous U from 4124° to 6000°K.

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.521			
298.15	6.598	11.995	11.995	0.000			
300	6.608	12.036	11.995	0.012			
400	7.074	14.002	12.260	0.697			
500	7.569	15.632	12.776	1.428			
600	8.193	17.065	13.373	2.215			
700	8.983	18.385	13.996	3.072			
800	9.953	19.646	14.624	4.018			
900	11.109	20.883	15.251	5.069			
940	11.625	21.377	15.501	5.524			
940	10.150	22.106	15.501	6.209			
1000	10.150	22.734	15.916	6.818			
1048	10.150	23.210	16.239	7.305			
1048	9.150	24.278	16.239	8.425			
1100	9.150	24.722	16.630	8.901			
1200	9.150	25.518	17.338	9.816			
1300	9.150	26.250	17.996	10.731			
1400	9.150	26.928	18.610	11.646			
1406	9.150	26.967	18.645	11.701			
1406	9.150	30.310	18.645	16.401			
1500	9.150	30.902	19.395	17.261			
1600	9.150	31.493	20.133	18.176			
1700	9.150	32.048	20.818	19.091			
1800	9.150	32.571	21.456	20.006			
1900	9.150	33.065	22.054	20.921			
2000	9.150	33.535	22.617	21.836			
2100	9.150	33.981	23.147	22.751			
2200	9.150	34.407	23.650	23.666			
2300	9.150	34.813	24.126	24.581			
2400	9.150	35.203	24.580	25.496			
2500	9.150	35.576	25.012	26.411			
2600	9.150	35.935	25.425	27.326			
2700	9.150	36.281	25.821	28.241			
2800	9.150	36.613	26.201	29.156			
2900	9.150	36.934	26.565	30.071			
3000	9.150	37.245	26.916	30.986			
3100	9.150	37.545	27.254	31.901			
3200	9.150	37.835	27.580	32.816			
3300	9.150	38.117	27.895	33.731			
3400	9.150	38.390	28.200	34.646			
3500	9.150	38.655	28.495	35.561			
3600	9.150	38.913	28.781	36.476			
3700	9.150	39.164	29.058	37.391			
3800	9.150	39.408	29.327	38.306			
3900	9.150	39.645	29.589	39.221			
4000	9.150	39.877	29.843	40.136			
4100	9.150	40.103	30.090	41.051			
4123.63	9.150	40.156	30.148	41.267			
4123.63	10.288	66.079	30.147	148.168			
4200	10.327	66.268	30.803	148.955			
4300	10.377	66.512	31.630	149.990			
4400	10.425	66.751	32.426	151.031			
4500	10.472	66.985	33.191	152.075			
4600	10.515	67.216	33.928	153.125			
4700	10.557	67.443	34.639	154.178			
4800	10.595	67.665	35.325	155.236			
4900	10.630	67.884	35.986	156.297			
5000	10.662	68.099	36.627	157.362			
5100	10.690	68.311	37.246	158.430			
5200	10.715	68.519	37.846	159.500			
5300	10.735	68.723	38.426	160.572			
5400	10.751	68.924	38.989	161.647			
5500	10.763	69.121	39.535	162.722			
5600	10.770	69.315	40.065	163.799			
5700	10.773	69.506	40.580	164.876			
5800	10.771	69.693	41.081	165.954			
5900	10.765	69.877	41.567	167.030			
6000	10.755	70.058	42.040	168.106			

15 June 1963

MBP

URANIUM (U)

(REFERENCE STATE)

gfw = 238.07

0°K to 1406°K
1406°K to 4124°K
4124°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$\Delta H_{f0}^0 = 0$	$\Delta H_{f298.15}^0 = 0$
$\Delta H_{f298.15}^0 = 117.064 \text{ kcal gfw}^{-1}$	$S_{298.15}^0 = 11.995 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$
$T_f = 940^\circ\text{K}$	$\Delta H_f = 0.685 \text{ kcal gfw}^{-1}$
$T_l = 1048^\circ\text{K}$	$\Delta H_l = 1.120 \text{ kcal gfw}^{-1}$
$T_m = 1406^\circ\text{K}$	$\Delta H_m = 4.700 \text{ kcal gfw}^{-1}$
$T_b = 4124^\circ\text{K}$	$\Delta H_v = 106.901 \text{ kcal gfw}^{-1}$
$H_{298.15}^0 - H_0^0 = 1.521 \text{ kcal gfw}^{-1}$	
$C_p^0 = \text{smoothed data}$	$298.15^\circ\text{K} \leq T \leq 940^\circ\text{K}$
$C_p^0 = 10.150 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$	$940^\circ\text{K} \leq T \leq 1048^\circ\text{K}$
$C_p^0 = 9.150 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$	$1048^\circ\text{K} \leq T \leq 4124^\circ\text{K}$

Structure

Elemental uranium exists in three modifications (α , β , and γ) below melting point.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low-temperature heat capacity by Flotow and Lohr.¹ High-temperature heat capacity from Ginnings and Corruccini.²

Melting and Vaporization

Heat of fusion based on work of Rauh and Thorn.³ Vapor-pressure data of Ackermann et al.⁴ and Rauh and Thorn³ adopted.

References

1. Flotow, H. E. and H. R. Lohr, J. Phys. Chem. 64, 904 (1960).
2. Ginnings, D. C. and R. J. Corruccini, J. Res. NBS 59, 309 (1947).
3. Rauh, E. G. and R. J. Thorn, J. Chem. Phys. 22, 1414 (1954).
4. Ackermann, R. J., E. G. Rauh, and R. J. Thorn, J. Chem. Phys. 37, 2693 (1962).

URANIUM (U)

(REFERENCE STATE)

GFW = 238.07

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p^0	S_f^0	$-(F_f^0 - H_{f298}^0)/T$	$H_f^0 - H_{f298}^0$	ΔH_f^0	ΔF_f^0	
298.15	± 0.030	± 0.050	± 0.050	± 0.000			
350	± 0.030	± 0.055	± 0.050	± 0.002			
350	± 0.040	± 0.055	± 0.050	± 0.002			
600	± 0.040	± 0.076	± 0.057	± 0.012			
600	± 0.100	± 0.076	± 0.057	± 0.012			
900	± 0.100	± 0.117	± 0.071	± 0.042			
900	± 0.500	± 0.117	± 0.071	± 0.042			
939	± 0.500	± 0.138	± 0.073	± 0.061			
939	± 0.600	± 0.138	± 0.073	± 0.061			
940	± 0.600	± 0.139	± 0.073	± 0.062			
940	± 0.700	± 0.192	± 0.073	± 0.112			
1000	± 0.200	± 0.204	± 0.081	± 0.124			
1048	± 0.200	± 0.214	± 0.087	± 0.133			
1048	± 0.200	± 0.261	± 0.087	± 0.183			
1406	± 0.200	± 0.320	± 0.139	± 0.255			
1406	± 0.400	± 0.462	± 0.139	± 0.455			
2000	± 0.400	± 0.603	± 0.257	± 0.692			
2000	± 1.000	± 0.603	± 0.257	± 0.692			
3000	± 1.000	± 1.009	± 0.445	± 1.692			
3000	± 1.500	± 1.009	± 0.445	± 1.692			
4000	± 1.500	± 1.440	± 0.642	± 3.192			
4123.63	± 1.500	± 1.486	± 0.667	± 3.377			
4123.63	± 2.000	± 1.534	± 0.667	± 3.577			
5000	± 2.000	± 1.920	± 0.854	± 5.330			
6000	± 2.000	± 2.284	± 1.062	± 7.330			

URANIUM

TABLE 242
IDEAL MONATOMIC GAS

U

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid U from 0° to 1406°K,
Liquid U from 1406° to 4124°K, Gaseous U from 4124° to 6000°K.

T, °K	C_p	S_T	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.553	117.032	117.032	INFINITE
298.15	5.663	47.726	47.726	0.000	117.064	106.411	-77.997
300	5.666	47.761	47.726	0.010	117.062	106.345	-77.468
400	5.724	49.404	47.950	0.582	116.949	102.788	-56.158
500	5.665	50.676	48.373	1.152	116.788	99.266	-43.387
600	5.593	51.702	46.845	1.714	116.563	95.781	-34.887
700	5.559	52.561	49.316	2.271	116.263	92.340	-28.828
800	5.580	53.304	49.769	2.828	115.874	88.948	-24.298
900	5.660	53.965	50.199	3.389	115.384	85.611	-20.788
940	5.707	54.212	50.365	3.617	115.157	84.292	-19.597
940	5.707	54.212	50.365	3.617	114.472	84.242	-19.597
1000	5.792	54.568	50.606	3.962	114.208	82.374	-18.002
1048	5.873	54.841	50.794	4.242	114.001	80.850	-16.860
1048	5.873	54.841	50.794	4.242	112.881	80.850	-16.860
1100	5.970	55.128	50.992	4.549	112.712	79.266	-15.748
1200	6.182	55.656	51.359	5.157	112.405	76.239	-13.884
1300	6.420	56.160	51.709	5.787	112.120	73.237	-12.312
1400	6.674	56.645	52.044	6.441	111.857	70.256	-10.967
1406	6.689	56.674	52.064	6.481	111.844	70.077	-10.892
1406	6.689	56.674	52.064	6.481	107.144	70.077	-10.892
1500	6.936	57.115	52.367	7.122	106.925	67.606	-9.850
1600	7.200	57.571	52.678	7.829	106.717	64.992	-8.877
1700	7.460	58.015	52.979	8.562	106.535	62.390	-8.020
1800	7.712	58.449	53.271	9.320	106.378	59.797	-7.260
1900	7.951	58.872	53.555	10.104	106.247	57.213	-6.581
2000	8.176	59.286	53.831	10.910	106.138	54.636	-5.970
2100	8.385	59.690	54.100	11.738	106.051	52.062	-5.418
2200	8.577	60.084	54.363	12.587	105.985	49.495	-4.917
2300	8.753	60.470	54.620	13.453	105.936	46.927	-4.459
2400	8.912	60.846	54.872	14.337	105.905	44.363	-4.040
2500	9.056	61.212	55.118	15.235	105.888	41.798	-3.654
2600	9.185	61.570	55.360	16.147	105.885	39.234	-3.298
2700	9.302	61.919	55.596	17.072	105.895	36.671	-2.968
2800	9.407	62.259	55.828	18.007	105.915	34.108	-2.662
2900	9.502	62.591	56.056	18.953	105.946	31.544	-2.377
3000	9.589	62.915	56.279	19.907	105.985	28.976	-2.111
3100	9.669	63.230	56.498	20.870	106.033	26.408	-1.862
3200	9.742	63.538	56.713	21.841	106.089	23.838	-1.628
3300	9.811	63.839	56.925	22.819	106.152	21.266	-1.408
3400	9.877	64.133	57.132	23.803	106.221	18.694	-1.202
3500	9.939	64.420	57.336	24.794	106.297	16.119	-1.006
3600	9.999	64.701	57.537	25.791	106.379	13.542	-0.822
3700	10.057	64.976	57.735	26.794	106.467	10.961	-0.647
3800	10.114	65.245	57.929	27.802	106.560	8.378	-0.482
3900	10.169	65.508	58.120	28.816	106.659	5.795	-0.325
4000	10.223	65.767	58.308	29.836	106.764	3.206	-0.175
4100	10.276	66.020	58.493	30.861	106.874	0.613	-0.033
4123.63	10.288	66.079	58.536	31.104	106.901	0.003	-0.000
4123.63	10.288	66.079	58.536	31.104			
4200	10.327	66.268	58.675	31.891			
4300	10.377	66.512	58.854	32.926			
4400	10.425	66.751	59.031	33.967			
4500	10.472	66.985	59.205	35.011			
4600	10.515	67.216	59.377	36.060			
4700	10.557	67.443	59.546	37.114			
4800	10.595	67.665	59.713	38.172			
4900	10.630	67.884	59.877	39.233			
5000	10.662	68.099	60.040	40.298			
5100	10.690	68.311	60.200	41.366			
5200	10.715	68.519	60.358	42.436			
5300	10.735	68.723	60.514	43.508			
5400	10.751	68.924	60.668	44.583			
5500	10.763	69.121	60.819	45.658			
5600	10.770	69.315	60.969	46.735			
5700	10.773	69.506	61.118	47.812			
5800	10.771	69.693	61.264	48.890			
5900	10.765	69.877	61.408	49.966			
6000	10.755	70.058	61.551	51.042			

15 June 1963

MBP

URANIUM (U)

(IDEAL MONATOMIC GAS)

gfw = 238.07

$$\Delta H_{f0}^{\circ} = 117.032 \text{ kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 117.064 \text{ kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.553 \text{ kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 47.726 \text{ cal deg K}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

Spectroscopic energy levels from Blaise.¹

Heat of Formation

Vapor-pressure data from Rauh and Thorn² adopted to calculate
 $\Delta H_{f298.15}^{\circ}$

Heat Capacity and Entropy

Calculated on monatomic-gas computer program.

References

1. Blaise, J., unpublished work, provided by C. M. Moore (Sitterly), NBS (1963).
2. Rauh, E. G. and R. J. Thorn, J. Chem. Phys. 22, 1414 (1954)

URANIUM, MONATOMIC (U)

(IDEAL GAS)

GFW = 238.07

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p	S_T	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log λ_p
298.15	* .000	* .002	* .002	* .000			
940	* .000	* .002	* .002	* .000			
1000	* .000	* .002	* .002	* .000			
1048	* .000	* .002	* .002	* .000			
1406	* .001	* .002	* .002	* .000			
2000	* .001	* .003	* .003	* .001			
3000	* .002	* .003	* .003	* .002			
4000	* .002	* .003	* .003	* .003			
5000	* .002	* .003	* .003	* .004			
6000	* .002	* .004	* .003	* .005			

TABLE 243

VANADIUM

REFERENCE STATE

V

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid V from 0° to 2190°K,
Liquid V from 2190° to 3648°K, Gaseous V from 3648° to 6000°K.

T, °K	C_p°	C_p°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.122			
298.15	5.894	6.880		6.880	0.000		
300	5.896	6.916		6.880	0.011		
400	6.057	8.633		7.113	0.608		
500	6.270	10.007		7.559	1.224		
600	6.504	11.170		8.066	1.863		
700	6.747	12.191		8.584	2.525		
800	6.995	13.108		9.093	3.212		
900	7.247	13.946		9.586	3.924		
1000	7.500	14.723		10.062	4.661		
1100	7.755	15.450		10.519	5.424		
1200	8.010	16.135		10.958	6.212		
1300	8.266	16.787		11.382	7.026		
1400	8.522	17.409		11.790	7.866		
1500	8.779	18.005		12.185	8.731		
1600	9.036	18.580		12.567	9.621		
1700	9.293	19.136		12.937	10.538		
1800	9.550	19.674		13.296	11.480		
1900	9.808	20.197		13.646	12.448		
2000	10.065	20.707		13.986	13.441		
2100	10.323	21.204		14.318	14.461		
2190	10.554	21.642		14.610	15.400		
2190	9.500	23.560		14.610	19.600		
2200	9.500	23.603		14.651	19.695		
2300	9.500	24.026		15.049	20.645		
2400	9.500	24.430		15.432	21.595		
2500	9.500	24.818		15.800	22.545		
2600	9.500	25.190		16.154	23.495		
2700	9.500	25.549		16.495	24.445		
2800	9.500	25.894		16.825	25.395		
2900	9.500	26.228		17.143	26.345		
3000	9.500	26.550		17.451	27.295		
3100	9.500	26.861		17.750	28.245		
3200	9.500	27.163		18.039	29.195		
3300	9.500	27.455		18.320	30.145		
3400	9.500	27.739		18.593	31.095		
3500	9.500	28.014		18.858	32.045		
3600	9.500	28.282		19.117	32.995		
3647.68	9.500	28.407		19.237	33.448		
3647.68	6.890	58.528		19.237	143.322		
3700	6.950	58.627		19.794	143.683		
3800	7.068	58.814		20.818	144.384		
3900	7.188	58.999		21.795	145.097		
4000	7.311	59.183		22.728	145.822		
4100	7.435	59.365		23.619	146.559		
4200	7.560	59.546		24.472	147.309		
4300	7.685	59.725		25.290	148.071		
4400	7.810	59.903		26.074	148.846		
4500	7.935	60.080		26.828	149.633		
4600	8.058	60.256		27.553	150.433		
4700	8.180	60.430		28.251	151.241		
4800	8.300	60.604		28.923	152.069		
4900	8.419	60.776		29.571	152.905		
5000	8.534	60.947		30.197	153.753		
5100	8.648	61.118		30.801	154.612		
5200	8.758	61.287		31.386	155.482		
5300	8.866	61.454		31.952	156.363		
5400	8.970	61.621		32.499	157.255		
5500	9.071	61.787		33.031	158.157		
5600	9.169	61.951		33.546	159.069		
5700	9.264	62.114		34.045	159.991		
5800	9.354	62.276		34.530	160.922		
5900	9.442	62.437		35.003	161.862		
6000	9.526	62.596		35.461	162.810		

15 March 1963

HLS

0°K to 2190°K
2190°K to 3648°K
3648°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{298.15}^{\circ} = 123.010 \text{ Kcal gfw}^{-1}$$

$$T_m = 2190^{\circ}\text{K}$$

$$T_b = 3647.68^{\circ}\text{K}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1122 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$S_{298.15}^{\circ} = 6.88 \pm 05 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$\Delta H_m = 4.2 \text{ Kcal gfw}^{-1}$$

$$\Delta H_v = 109.874 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 4.90 + 2.58 \times 10^{-3}T + 0.20 \times 10^{-5}T^{-2} \text{ cal deg}^{-1} \text{ gfw}^{-1} \quad 298.15^{\circ}\text{K} \leq T \leq 2190^{\circ}\text{K}$$

$$C_p^{\circ} = 9.5 \pm 1 \text{ cal deg}^{-1} \text{ gfw}^{-1} \text{ for liquid } (2190^{\circ}\text{K} \leq T \leq 3648^{\circ}\text{K}) \text{ (Estd)}$$

Structure

Solid has b. c. c. A2 type structure to melting point.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low temperature data by Anderson,¹ Stull and Sinke,² and Bieganski and Stalinski³
High temperature data from Kelley.⁴ Liquid heat capacity estimated by Kelley⁴

Melting

Estimated by Stull and Sinke.²

Heat of Sublimation

Recalculation of vapor pressure data of Edwards *et al*⁵

References

- Anderson, C. T., J. Am. Chem. Soc. 52, 2296 (1930).
- Stull, D. R. and G. Sinke, *Thermodynamic Properties of the Elements* (1956).
- Bieganski, Z. and B. Stalinski, *Bull. de l'acad. Pol. des sci. Serie des science Chim.* 9, 367 (1961)
- Kelley, K. K., Bur. Mines, Bull. 584 (1960)
- Edwards, J., H. Johnston and P. Blackburn, J. Am. Chem. Soc. 73, 4727 (1951)

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔF _f ^o	
298.15	±0.050	±0.050	±0.050	±0.000			
1000	±0.200	±0.214	±0.104	±0.110			
2000	±1.000	±0.583	±0.228	±0.710			
2190	±1.000	±0.674	±0.263	±0.900			
2190	±2.000	±1.131	±0.263	±1.900			
3000	±2.000	±1.760	±0.587	±3.520			
3647.68	±2.000	±2.125	±0.814	±4.720			
3647.68	±0.001	±0.003					
4000	±0.001	±0.003					
5000	±0.002	±0.003					
6000	±0.003	±0.004					

TABLE 244

VANADIUM

IDEAL MONATOMIC GAS

V

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid V from 0° to 2190°K,
Liquid V from 2190° to 3648°K, Gaseous V from 3648° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.890	122.242	122.242	INFINITE
298.15	6.217	43.546	43.546	0.000	123.010	112.078	-82.152
300	6.209	43.584	43.546	0.011	123.010	112.010	-81.595
400	5.891	45.321	43.785	0.615	123.017	108.341	-59.192
500	5.783	46.621	44.227	1.197	122.983	104.676	-45.752
600	5.804	47.676	44.717	1.775	122.922	101.019	-36.795
700	5.875	48.576	45.205	2.359	122.844	97.375	-30.400
800	5.949	49.365	45.677	2.951	122.749	93.743	-25.608
900	6.003	50.069	46.127	3.548	122.634	90.123	-21.884
1000	6.032	50.704	46.553	4.150	122.499	86.519	-18.908
1100	6.038	51.279	46.957	4.754	122.340	82.928	-16.476
1200	6.026	51.804	47.339	5.357	122.155	79.352	-14.451
1300	6.003	52.285	47.702	5.959	121.943	75.795	-12.742
1400	5.974	52.729	48.045	6.558	121.702	72.253	-11.279
1500	5.943	53.140	48.371	7.154	121.433	68.731	-10.014
1600	5.913	53.523	48.681	7.746	121.135	65.227	-8.909
1700	5.887	53.881	48.977	8.336	120.808	61.742	-7.937
1800	5.867	54.216	49.259	8.924	120.454	58.277	-7.075
1900	5.853	54.533	49.528	9.510	120.072	54.834	-6.307
2000	5.846	54.833	49.786	10.095	119.664	51.410	-5.618
2100	5.848	55.119	50.033	10.680	119.229	48.008	-4.996
2190	5.857	55.364	50.247	11.206	118.816	44.965	-4.487
2190	5.857	55.364	50.247	11.206	114.616	44.965	-4.487
2200	5.858	55.391	50.270	11.265	114.580	44.647	-4.435
2300	5.877	55.652	50.499	11.851	114.216	41.476	-3.941
2400	5.904	55.902	50.719	12.440	113.855	38.322	-3.490
2500	5.940	56.144	50.931	13.033	113.498	35.183	-3.076
2600	5.985	56.378	51.136	13.629	113.144	32.057	-2.694
2700	6.038	56.605	51.334	14.230	112.795	28.944	-2.343
2800	6.099	56.825	51.526	14.837	112.452	25.846	-2.017
2900	6.168	57.040	51.713	15.450	112.115	22.757	-1.715
3000	6.245	57.251	51.894	16.070	111.785	19.681	-1.434
3100	6.328	57.457	52.070	16.699	111.464	16.617	-1.171
3200	6.418	57.659	52.242	17.336	111.151	13.561	-0.926
3300	6.515	57.858	52.409	17.983	110.848	10.517	-0.696
3400	6.617	58.054	52.572	18.639	110.554	7.481	-0.481
3500	6.723	58.248	52.731	19.306	110.271	4.453	-0.278
3600	6.835	58.439	52.887	19.984	109.999	1.437	-0.087
3647.68	6.889	58.529	52.960	20.311	109.873	-0.002	0.000
3647.68	6.889	58.529	52.960	20.311			
3700	6.950	58.627	53.040	20.673			
3800	7.068	58.814	53.189	21.374			
3900	7.188	58.999	53.336	22.087			
4000	7.311	59.183	53.480	22.812			
4100	7.435	59.365	53.621	23.549			
4200	7.560	59.546	53.760	24.299			
4300	7.685	59.725	53.897	25.061			
4400	7.810	59.901	54.031	25.836			
4500	7.935	60.080	54.164	26.623			
4600	8.058	60.256	54.294	27.423			
4700	8.180	60.430	54.423	28.235			
4800	8.300	60.604	54.550	29.059			
4900	8.419	60.776	54.675	29.895			
5000	8.534	60.947	54.799	30.743			
5100	8.648	61.118	54.921	31.602			
5200	8.758	61.287	55.047	32.472			
5300	8.866	61.454	55.161	33.353			
5400	8.970	61.621	55.279	34.245			
5500	9.071	61.787	55.396	35.147			
5600	9.169	61.951	55.517	36.059			
5700	9.264	62.114	55.626	36.981			
5800	9.354	62.276	55.739	37.912			
5900	9.442	62.437	55.852	38.852			
6000	9.526	62.596	55.963	39.800			

15 March 1963

HLS

$$\Delta H_{f0}^{\circ} = 122.242 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $4F_{1\frac{1}{2}}$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.890 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 123.010 \pm 4.0 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 43.546 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

All energy levels listed by Moore¹ were used.

Heat of Formation

The vapor pressure data of Edwards, Johnston and Blackburn² were used

Heat Capacity and Entropy

Calculated using the monatomic gas program.

References

1. Moore, C., Nat. Bur. Std. (U S.), Circ. 467, Vol. 1 (1949).
2. Edwards, J., H. Johnston and P. Blackburn, J. Am. Chem. Soc. 73, 4727 (1951)

VANADIUM, MONATOMIC (V)

(IDEAL GAS)

GFW = 50.95

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	± 0.000	± 0.002	± 0.003	± 0.000	± 4.000		
1000	± 0.000	± 0.002	± 0.003	± 0.000			
2000	± 0.000	± 0.003	± 0.003	± 0.001			
3000	± 0.001	± 0.003	± 0.003	± 0.001			
3647.68	± 0.001	± 0.003	± 0.003	± 0.002			
4000	± 0.001	± 0.003	± 0.003	± 0.002			
5000	± 0.002	± 0.003	± 0.003	± 0.003			
6000	± 0.003	± 0.004	± 0.003	± 0.003			

TABLE 245

TUNGSTEN

REFERENCE STATE

W

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid W from 0° to 3650°K,
Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K.

T, °K	C_p°	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.195			
298.15	5.800	7.830	7.830	0.000			
300	5.810	7.866	7.830	0.011			
400	5.960	9.580	8.082	0.599			
500	6.040	10.901	8.501	1.200			
600	6.110	12.027	9.015	1.807			
700	6.180	12.955	9.496	2.421			
800	6.240	13.803	9.999	3.043			
900	6.300	14.523	10.444	3.671			
1000	6.360	15.209	10.906	4.303			
1100	6.430	15.799	11.305	4.943			
1200	6.520	16.382	11.724	5.589			
1300	6.650	16.888	12.082	6.248			
1400	6.800	17.386	12.442	6.921			
1500	6.950	17.860	12.788	7.608			
1600	7.100	18.313	13.119	8.311			
1700	7.250	18.748	13.437	9.028			
1800	7.400	19.167	13.744	9.761			
1900	7.550	19.571	14.040	10.508			
2000	7.700	19.962	14.326	11.271			
2100	7.850	20.342	14.605	12.048			
2200	8.000	20.710	14.873	12.841			
2300	8.150	21.069	15.135	13.648			
2400	8.300	21.419	15.389	14.471			
2500	8.450	21.761	15.638	15.308			
2600	8.600	22.095	15.879	16.161			
2700	8.750	22.423	16.116	17.028			
2800	8.900	22.744	16.347	17.911			
2900	9.050	23.059	16.573	18.808			
3000	9.200	23.368	16.794	19.721			
3100	9.350	23.672	17.011	20.648			
3200	9.500	23.971	17.224	21.591			
3300	9.650	24.266	17.433	22.548			
3400	9.800	24.556	17.638	23.521			
3500	9.950	24.842	17.840	24.508			
3600	10.100	25.125	18.039	25.511			
3650	10.175	25.265	18.137	26.017			
3650	10.000	27.565	18.137	34.412			
3700	10.000	27.701	18.265	34.742			
3800	10.000	27.968	18.517	35.912			
3900	10.000	28.227	18.762	36.912			
4000	10.000	28.481	19.003	37.912			
4100	10.000	28.727	19.236	38.912			
4200	10.000	28.968	19.465	39.912			
4300	10.000	29.204	19.690	40.912			
4400	10.000	29.434	19.909	41.912			
4500	10.000	29.658	20.122	42.912			
4600	10.000	29.878	20.332	43.912			
4700	10.000	30.093	20.537	44.912			
4800	10.000	30.304	20.739	45.912			
4900	10.000	30.510	20.936	46.912			
5000	10.000	30.712	21.130	47.912			
5100	10.000	30.910	21.319	48.912			
5200	10.000	31.104	21.506	49.912			
5300	10.000	31.295	21.689	50.912			
5400	10.000	31.482	21.869	51.912			
5500	10.000	31.665	22.045	52.912			
5600	10.000	31.845	22.218	53.912			
5700	10.000	32.022	22.388	54.912			
5800	10.000	32.196	22.556	55.912			
5891	10.000	32.352	22.706	56.822			
5891	9.682	64.988	22.706	249.087			
5900	9.688	65.003	22.770	249.174			
6000	9.753	65.166	23.475	250.146			

May 1962

CHW

TUNGSTEN (W)

(REFERENCE STATE)

gfw = 183.86

0 °K to 3650 °K Crystal

3650 °K to 5891 °K Liquid

5891 °K to 6000 °K Ideal Monatomic Gas

$\Delta H_{f0}^{\circ} = 0$

$\Delta H_{f298.15}^{\circ} = 0$

$\Delta H_{s298.15}^{\circ} = 203.100 \text{ Kcal gfw}^{-1}$

$S_{298.15}^{\circ} = 7.830 \text{ cal degK}^{-1} \text{ gfw}^{-1}$

$T_m = 3650 \text{ °K}$

$\Delta H_m = 8.395 \text{ Kcal gfw}^{-1}$

$T_b = 5891 \text{ °K}$

$\Delta H_v = 192.265 \text{ Kcal gfw}^{-1}$

$H_{298.15}^{\circ} - H_0^{\circ} = 1.195 \text{ Kcal gfw}^{-1}$

$C_p^{\circ} = 4.70 + 1.5 \times 10^{-3} T \text{ cal degK}^{-1} \text{ gfw}^{-1}$

$130^{\circ}\text{K} \leq T \leq 3650^{\circ}\text{K}$

$C_p^{\circ} = 10 \text{ cal degK}^{-1} \text{ gfw}^{-1}$

$3650^{\circ}\text{K} \leq T \leq 5891^{\circ}\text{K}$

Structure

Tungsten exists with the b. c. c. structure.

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low temperature data by Clusius and Franzosini¹. These data were joined smoothly to the equation given above based on Schomaker et al². Data for liquid tungsten were estimated.

Melting

Several values had been reported. The value adopted is consistent with several other computations.

Vaporization

Based on two experimental determinations. See Barriault et al³ for details.

References

1. Clusius, K., and P. Franzosini, Z. Naturforsch. A14 99 (1959).
2. Schomaker, V., et al, Contract DA-30-069-ORD-2787, Prog. Rept. (31 Dec. 1960).
3. Barriault, R., et al, ASD TR-61-260 May (1962), Pt. I.

TUNGSTEN (W)

(REFERENCE STATE)

GFW = 183.86

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C_p°	S_T°	$-(T - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	
298.15	± 0.100	± 0.050	± 0.050	± 0.000			
1000	± 0.500	± 0.410	± 0.200	± 0.210			
2000	± 0.500	± 0.760	± 0.410	± 0.710			
3000	± 1.000	± 1.060	± 0.570	± 1.460			
3650	± 1.500	± 1.300	± 0.680	± 2.270			
3650	± 2.000	± 1.580	± 0.680	± 3.270			
4000	± 2.000	± 1.760	± 0.770	± 3.970			
5000	± 3.000	± 2.320	± 1.030	± 6.470			
5891	± 4.000	± 2.890	± 1.260	± 9.590			
5891	± 0.007	± 0.005					
6000	± 0.007	± 0.005					

TABLE 246

TUNGSTEN

IDEAL MONATOMIC GAS

W

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid W from 0° to 3650°K,
Liquid W from 3650° to 5891°K, Gaseous W from 5891° to 6000°K.

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.486	202.809	202.809	INFINITE
298.15	5.092	41.551	41.551	0.000	203.100	193.046	-141.500
300	5.097	41.583	41.551	0.009	203.098	192.983	-140.582
400	5.536	43.101	41.755	0.538	203.039	189.631	-103.604
500	6.297	44.413	42.158	1.128	203.028	186.272	-81.415
600	7.251	45.643	42.637	1.804	203.097	182.927	-66.628
700	7.218	46.835	43.152	2.578	203.257	179.541	-56.053
800	9.026	47.987	43.685	3.442	203.499	176.151	-48.120
900	9.577	49.085	44.224	4.375	203.804	172.697	-41.935
1000	9.586	50.111	44.762	5.348	204.145	169.244	-36.986
1100	9.904	51.054	45.292	6.338	204.495	165.714	-32.923
1200	9.788	51.912	45.809	7.324	204.835	162.197	-29.539
1300	9.569	52.687	46.308	8.292	205.144	158.607	-26.663
1400	9.298	53.387	46.789	9.236	205.415	155.015	-24.198
1500	9.008	54.018	47.251	10.151	205.643	151.407	-22.059
1600	8.721	54.590	47.692	11.038	205.827	147.784	-20.185
1700	8.451	55.111	48.113	11.896	205.968	144.153	-18.531
1800	8.206	55.587	48.515	12.729	206.068	140.513	-17.060
1900	7.987	56.025	48.899	13.538	206.130	136.870	-15.743
2000	7.797	56.429	49.266	14.327	206.150	133.220	-14.557
2100	7.635	56.806	49.616	15.098	206.150	129.576	-13.485
2200	7.500	57.158	49.951	15.855	206.114	125.930	-12.509
2300	7.391	57.489	50.271	16.599	206.051	122.286	-11.619
2400	7.296	57.801	50.579	17.334	205.963	118.646	-10.804
2500	7.243	58.098	50.874	18.061	205.853	115.010	-10.054
2600	7.201	58.381	51.157	18.783	205.722	111.379	-9.362
2700	7.179	58.653	51.430	19.502	205.574	107.752	-8.721
2800	7.173	58.913	51.692	20.220	205.409	104.132	-8.127
2900	7.184	59.165	51.946	20.937	205.229	100.520	-7.575
3000	7.209	59.409	52.190	21.657	205.036	96.909	-7.059
3100	7.247	59.646	52.427	22.380	204.832	93.310	-6.578
3200	7.297	59.877	52.656	23.107	204.616	89.718	-6.127
3300	7.357	60.103	52.878	23.839	204.391	86.130	-5.704
3400	7.426	60.323	53.094	24.578	204.157	82.552	-5.306
3500	7.503	60.540	53.304	25.325	203.917	78.974	-4.931
3600	7.586	60.752	53.508	26.079	203.668	75.413	-4.578
3650	7.630	60.857	53.608	26.460	203.543	73.631	-4.409
3650	7.630	60.857	53.608	26.460	195.148	73.631	-4.409
3700	7.675	60.961	53.706	26.842	195.030	71.969	-4.251
3800	7.769	61.167	53.900	27.615	194.803	68.647	-3.948
3900	7.866	61.370	54.089	28.396	194.584	65.325	-3.661
4000	7.965	61.570	54.274	29.118	194.376	62.016	-3.388
4100	8.067	61.768	54.454	29.989	194.177	58.704	-3.129
4200	8.169	61.964	54.630	30.801	193.989	55.401	-2.883
4300	8.273	62.157	54.803	31.623	193.813	52.116	-2.649
4400	8.376	62.349	54.973	32.456	193.644	48.818	-2.425
4500	8.478	62.538	55.139	33.298	193.486	45.522	-2.211
4600	8.580	62.726	55.301	34.151	193.339	42.242	-2.007
4700	8.680	62.911	55.461	35.014	193.202	38.963	-1.812
4800	8.778	63.095	55.619	35.887	193.075	35.674	-1.624
4900	8.874	63.277	55.773	36.770	192.958	32.399	-1.445
5000	8.968	63.457	55.925	37.662	192.850	29.125	-1.273
5100	9.059	63.636	56.074	38.563	192.751	25.852	-1.108
5200	9.148	63.812	56.221	39.473	192.661	22.584	-0.949
5300	9.234	63.988	56.366	40.393	192.581	19.312	-0.795
5400	9.317	64.161	56.509	41.320	192.508	16.043	-0.649
5500	9.397	64.333	56.650	42.256	192.444	12.771	-0.507
5600	9.474	64.503	56.788	43.199	192.387	9.509	-0.371
5700	9.548	64.671	56.925	44.150	192.338	6.242	-0.239
5800	9.619	64.838	57.060	45.109	192.297	2.975	-0.112
5891	9.682	64.988	57.181	45.987	192.265	0.000	0.000
5891	9.682	64.988	57.181	45.987			
5900	9.688	65.003	57.193	46.074			
6000	9.753	65.166	57.325	47.046			

May 1962

CHW

TUNGSTEN, MONATOMIC (W) (IDEAL GAS)

gfw = 183.86

$$\Delta H_{f0}^{\circ} = 202.809 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 203.100 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $5D_0$

$$S_{298.15}^{\circ} = 41.551 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.486 \text{ Kcal gfw}^{-1}$$

Electronic levels and multiplicities

Atomic energy levels from Moore¹.

Heat of Formation

Based on experimental vaporization studies by Jones et al² and Zwikker³. Details given by Barriault et al⁴.

Heat Capacity and Entropy

Calculated on monatomic gas computer program.

References

1. Moore, C., Atomic Energy Levels, Vol. III, Nat. Bur. Stds. (1958).
2. Jones, H. A., I. Langmuir, G. MacKay, Phys. Rev. 30, 201 (1927).
3. Zwikker, C., Physica 5, 249 (1925).
4. Barriault, R., et al, ASD TR-61-260 (May 1962), Pt. I.

TUNGSTEN, MONATOMIC (W)

(IDEAL GAS)

GFW = 183.86

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal / °K gfw			Kcal gfw			
	C_p°	S_T°	$-(F_T^{\circ} - H_{298}^{\circ})/T$	$H_T^{\circ} - H_{298}^{\circ}$	ΔH_f°	ΔF_f°	Log K _p
298.15	± 0.000	± 0.002	± 0.002	± 0.000	± 1.800	± 1.820	± 1.330
1000	± 0.001	± 0.003	± 0.003	± 0.001	± 2.010	± 2.000	± 0.440
2000	± 0.001	± 0.003	± 0.003	± 0.001	± 2.510	± 2.630	± 0.290
3000	± 0.001	± 0.003	± 0.003	± 0.002	± 3.260	± 3.520	± 0.260
3650	± 0.002	± 0.003	± 0.003	± 0.002	± 4.070	± 4.290	± 0.260
3650	± 0.002	± 0.003	± 0.003	± 0.002	± 5.070	± 4.290	± 0.260
4000	± 0.003	± 0.003	± 0.003	± 0.003	± 5.770	± 4.890	± 0.270
5000	± 0.006	± 0.005	± 0.003	± 0.007	± 8.280	± 6.970	± 0.300
5891	± 0.007	± 0.005	± 0.003	± 0.012	± 1.140	± 9.240	± 0.340
5891	± 0.007	± 0.005	± 0.003	± 0.012			
6000	± 0.007	± 0.005	± 0.003	± 0.013			

TABLE 247

YTTRIUM

REFERENCE STATE

Y

Reference State for Calculating ΔH_f° , ΔF_f° , and Log K_p : Solid Y from 0° to 1803°K,
Liquid Y from 1803° to 3605°K, Gaseous Y from 3605° to 6000°K.

T, °K	C_p°	S_T°	$\frac{\text{cal/}^\circ\text{K gfw}}{-(F_T^\circ - H_{298}^\circ)/T}$	$\frac{\text{Kcal/gfw}}{H_T^\circ - H_{298}^\circ}$	ΔH_f°	ΔF_f°	Log K_p
0	0.000	0.000	INFINITE	-1.426			
298.15	6.349	10.630	10.630	0.000			
300	6.352	10.669	10.630	0.012			
400	6.509	12.518	10.881	0.655			
500	6.669	13.987	11.360	1.314			
600	6.832	15.218	11.903	1.989			
700	6.998	16.283	12.455	2.680			
800	7.168	17.229	12.993	3.388			
900	7.340	18.083	13.512	4.114			
1000	7.516	18.865	14.009	4.857			
1100	7.695	19.590	14.484	5.617			
1200	7.876	20.267	14.938	6.396			
1300	8.061	20.905	15.373	7.192			
1400	8.249	21.509	15.789	8.008			
1500	8.441	22.085	16.190	8.842			
1600	8.635	22.636	16.576	9.696			
1700	8.832	23.165	16.948	10.569			
1758	8.948	23.464	17.158	11.085			
1758	8.371	24.140	17.158	12.274			
1800	8.371	24.338	17.323	12.676			
1803	8.371	24.352	17.335	12.651			
1803	10.303	25.867	17.335	15.383			
1900	10.303	26.407	17.784	16.382			
2000	10.303	26.935	18.229	17.412			
2100	10.303	27.438	18.656	18.443			
2200	10.303	27.917	19.066	19.473			
2300	10.303	28.375	19.461	20.503			
2400	10.303	28.814	19.841	21.534			
2500	10.303	29.234	20.209	22.564			
2600	10.303	29.638	20.564	23.594			
2700	10.303	30.027	20.907	24.625			
2800	10.303	30.402	21.239	25.655			
2900	10.303	30.763	21.562	26.685			
3000	10.303	31.113	21.874	27.715			
3100	10.303	31.450	22.178	28.746			
3200	10.303	31.778	22.473	29.776			
3300	10.303	32.095	22.759	30.806			
3400	10.303	32.402	23.038	31.837			
3500	10.303	32.701	23.310	32.867			
3600	10.303	32.991	23.575	33.897			
3604.68	10.303	33.004	23.587	33.945			
3604.68	8.004	57.262	23.587	120.623			
3700	8.237	57.485	24.457	121.396			
3800	8.477	57.708	25.318	122.232			
3900	8.714	57.931	26.146	123.092			
4000	8.944	58.155	26.937	123.975			
4100	9.166	58.378	27.696	124.880			
4200	9.380	58.602	28.424	125.808			
4300	9.583	58.824	29.124	126.756			
4400	9.774	59.046	29.796	127.724			
4500	9.954	59.266	30.443	128.710			
4600	10.121	59.486	31.068	129.714			
4700	10.276	59.704	31.670	130.734			
4800	10.417	59.920	32.251	131.769			
4900	10.544	60.134	32.814	132.817			
5000	10.659	60.346	33.359	133.877			
5100	10.761	60.556	33.885	134.948			
5200	10.850	60.763	34.396	136.029			
5300	10.927	60.968	34.892	137.118			
5400	10.992	61.170	35.373	138.214			
5500	11.046	61.370	35.840	139.316			
5600	11.090	61.566	36.294	140.423			
5700	11.123	61.760	36.735	141.529			
5800	11.148	61.951	37.166	142.647			
5900	11.164	62.138	37.584	143.763			
6000	11.172	62.327	37.992	144.880			

15 Marcy 1963

MG

0°K to 1803°K	Crystal
1803°K to 3605°K	Liquid
3605°K to 6000°K	Ideal Monatomic Gas

$$\Delta H_{f0}^{\circ} = 0$$

$$\Delta H_{f298.15}^{\circ} = 0$$

$$\Delta H_{s298.15}^{\circ} = 101.326 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 10.630 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$T_t = 1758^{\circ}\text{K}$$

$$\Delta H_t = 1.189 \text{ Kcal gfw}^{-1}$$

$$T_m = 1803^{\circ}\text{K}$$

$$\Delta H_m = 2.732 \text{ Kcal gfw}^{-1}$$

$$T_b = 3604.68^{\circ}\text{K}$$

$$\Delta H_v = 86.678 \text{ Kcal gfw}^{-1}$$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.426 \text{ Kcal gfw}^{-1}$$

$$C_p^{\circ} = 5.899 + 1.462 \times 10^{-3}T + 15.492 \times 10^{-8}T^2 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

$$273.15^{\circ}\text{K} \leq T \leq 1758^{\circ}\text{K}$$

$$C_p^{\circ} = 8.371 \text{ cal degK}^{-1} \text{ gfw}^{-1} \text{ for } 1758^{\circ} \leq T \leq 1803^{\circ}\text{K}; C_p^{\circ} = 10.303 \text{ cal degK}^{-1} \text{ gfw}^{-1} \text{ for liquid}$$

Structure.

h. c. p. to 1758°K; b. c. c. from 1758° to 1803°K

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low temperature data by Jennings et al.¹ High temperature data by Berg.²

Melting

Melting points, heat of transition, and heat of fusion from Berg.²

Heat of Sublimation

Vaporization data from Ackermann and Rauh³ were used.

References

1. Jennings, L. D., R. E. Miller and F. H. Spedding, J. Chem. Phys. 33, 1849 (1960)
2. Berg, J. R., Ph. D. Thesis, Iowa State Univ. (1961).
3. Ackermann, R. J. and E. G. Rauh, J. Chem. Phys. 36, 448 (1962).

TABLE 248

YTTRIUM

IDEAL MONATOMIC GAS

Y

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Y from 0° to 1803°K,
Liquid Y from 1803° to 3605°K, Gaseous Y from 3605° to 6000°K

T, °K	$\overset{\text{cal/°K gfw}}{C_p^\circ}$	$\overset{\text{cal/°K gfw}}{S_T^\circ}$	$\overset{\text{cal/°K gfw}}{-(F_T^\circ - H_{298}^\circ)/T}$	$\overset{\text{Kcal/gfw}}{H_T^\circ - H_{298}^\circ}$	$\overset{\text{Kcal/gfw}}{\Delta H_f^\circ}$	$\overset{\text{Kcal/gfw}}{\Delta F_f^\circ}$	$\log K_p$
0	0.000	0.000	INFINITE	-1.639	101.539	101.539	INFINITE
298.15	6.181	42.870	42.870	0.000	101.326	91.714	-67.225
300	6.181	42.909	42.871	0.011	101.325	91.654	-66.767
400	6.045	44.673	43.112	0.624	101.295	88.434	-48.316
500	5.826	45.999	43.563	1.218	101.230	85.225	-37.250
600	5.638	47.044	44.059	1.791	101.128	82.033	-29.879
700	5.494	47.901	44.548	2.347	100.993	78.861	-24.620
800	5.388	48.628	45.014	2.891	100.829	75.709	-20.682
900	5.308	49.258	45.451	3.426	100.638	72.581	-17.624
1000	5.249	49.814	45.860	3.953	100.422	69.475	-15.183
1100	5.203	50.312	46.243	4.476	100.185	66.391	-13.190
1200	5.169	50.763	46.601	4.994	99.924	63.331	-11.534
1300	5.144	51.175	46.937	5.510	99.644	60.293	-10.136
1400	5.127	51.556	47.254	6.023	99.341	57.275	-8.941
1500	5.119	51.909	47.552	6.536	99.020	54.283	-7.909
1600	5.120	52.240	47.835	7.047	98.677	51.312	-7.009
1700	5.130	52.550	48.103	7.560	98.317	48.363	-6.217
1758	5.143	52.721	48.251	7.590	97.831	46.665	-5.801
1758	5.143	52.721	48.251	7.590	96.642	46.665	-5.801
1800	5.153	52.844	48.359	8.074	96.774	45.461	-5.520
1803	5.154	52.852	48.366	8.090	96.765	45.377	-5.500
1803	5.154	52.852	48.366	8.090	94.033	45.377	-5.500
1900	5.187	53.124	48.602	8.591	93.535	42.772	-4.920
2000	5.235	53.391	48.835	9.112	93.026	40.114	-4.383
2100	5.298	53.648	49.058	9.638	92.521	37.482	-3.901
2200	5.377	53.896	49.272	10.172	92.025	34.873	-3.464
2300	5.472	54.137	49.479	10.714	91.537	32.285	-3.068
2400	5.584	54.372	49.678	11.267	91.059	29.718	-2.706
2500	5.713	54.603	49.870	11.832	90.594	27.174	-2.375
2600	5.858	54.830	50.056	12.410	90.142	24.647	-2.072
2700	6.020	55.054	50.237	13.004	89.705	22.135	-1.792
2800	6.198	55.276	50.413	13.615	89.286	19.639	-1.533
2900	6.389	55.497	50.585	14.244	88.885	17.160	-1.293
3000	6.594	55.717	50.752	14.893	88.504	14.692	-1.070
3100	6.810	55.936	50.916	15.563	88.143	12.238	-0.863
3200	7.035	56.156	51.076	16.255	87.805	9.797	-0.669
3300	7.268	56.376	51.234	16.970	87.490	7.359	-0.487
3400	7.507	56.597	51.388	17.709	87.198	4.936	-0.317
3500	7.750	56.818	51.540	18.472	86.931	2.521	-0.157
3600	7.993	57.039	51.690	19.259	86.688	0.112	-0.007
3604.68	8.004	57.049	51.697	19.297	86.678	-0.001	0.000
3604.68	8.004	57.049	51.697	19.297			
3700	8.237	57.262	51.837	20.070			
3800	8.477	57.485	51.983	20.906			
3900	8.714	57.708	52.127	21.766			
4000	8.944	57.931	52.269	22.649			
4100	9.166	58.155	52.410	23.554			
4200	9.380	58.378	52.549	24.482			
4300	9.583	58.602	52.688	25.430			
4400	9.774	58.824	52.825	26.398			
4500	9.954	59.046	52.960	27.384			
4600	10.121	59.266	53.095	28.388			
4700	10.276	59.486	53.229	29.408			
4800	10.417	59.704	53.361	30.443			
4900	10.544	59.920	53.493	31.491			
5000	10.659	60.134	53.624	32.551			
5100	10.761	60.346	53.753	33.622			
5200	10.850	60.556	53.882	34.703			
5300	10.927	60.763	54.010	35.792			
5400	10.992	60.968	54.137	36.888			
5500	11.046	61.170	54.263	37.990			
5600	11.090	61.370	54.388	39.097			
5700	11.123	61.566	54.512	40.208			
5800	11.148	61.760	54.636	41.321			
5900	11.164	61.951	54.758	42.437			
6000	11.172	62.138	54.880	43.554			

15 March 1963

MG

$$\Delta H_{f0}^{\circ} = 101.539 \text{ Kcal gfw}^{-1}$$

Ground State Configuration $^2D_{3/2}$

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.639 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 101.326 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 42.870 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

Energy levels from Moore.¹

Heat of Formation

Based on data of Ackermann and Rauh.²

Heat Capacity and Entropy

Calculated on monatomic gas program.

References

1. Moore, C. E., Nat. Bur. Std. (U. S.), Circ. 467, Vol. II (1952).
2. Ackermann, R. J. and E. G. Rauh, J. Chem. Phys. 36, 448 (1962).

TABLE 249

ZIRCONIUM

REFERENCE STATE

Zr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Zr from 0° to 2125°K,
Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K.

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.313			
298.15	6.001	9.290	9.290	0.000			
300	6.015	9.327	9.290	0.011			
400	6.555	11.140	9.534	0.642			
500	6.882	12.640	10.009	1.315			
600	7.124	13.917	10.557	2.016			
700	7.327	15.031	11.118	2.739			
800	7.508	16.021	11.670	3.481			
900	7.677	16.915	12.204	4.240			
1000	7.838	17.732	12.717	5.016			
1100	7.994	18.487	13.207	5.808			
1135	8.048	18.738	13.374	6.088			
1135	7.900	19.544	13.374	7.003			
1200	7.900	19.984	13.720	7.517			
1300	7.900	20.617	14.227	8.307			
1400	7.900	21.202	14.704	9.097			
1500	7.900	21.747	15.156	9.887			
1600	7.900	22.257	15.584	10.677			
1700	7.900	22.736	15.991	11.467			
1800	7.900	23.187	16.378	12.257			
1900	7.900	23.614	16.748	13.047			
2000	7.900	24.020	17.101	13.837			
2100	7.900	24.405	17.440	14.627			
2125	7.900	24.499	17.523	14.824			
2125	8.000	26.805	17.523	19.724			
2200	8.000	27.082	17.844	20.324			
2300	8.000	27.438	18.253	21.124			
2400	8.000	27.778	18.643	21.924			
2500	8.000	28.105	19.015	22.724			
2600	8.000	28.418	19.371	23.524			
2700	8.000	28.720	19.711	24.324			
2800	8.000	29.011	20.038	25.124			
2900	8.000	29.292	20.353	25.924			
3000	8.000	29.563	20.655	26.724			
3100	8.000	29.826	20.947	27.524			
3200	8.000	30.080	21.228	28.324			
3300	8.000	30.326	21.500	29.124			
3400	8.000	30.565	21.763	29.924			
3500	8.000	30.796	22.018	30.724			
3600	8.000	31.022	22.265	31.524			
3700	8.000	31.241	22.505	32.324			
3800	8.000	31.454	22.737	33.124			
3900	8.000	31.662	22.964	33.924			
4000	8.000	31.865	23.184	34.724			
4100	8.000	32.062	23.398	35.524			
4200	8.000	32.255	23.606	36.324			
4300	8.000	32.443	23.810	37.124			
4400	8.000	32.627	24.008	37.924			
4500	8.000	32.807	24.202	38.724			
4600	8.000	32.983	24.391	39.524			
4644.05	8.000	33.059	24.473	39.876			
4644.05	8.952	62.226	24.473	175.130			
4700	8.984	62.334	24.923	175.832			
4800	9.039	62.524	25.704	176.733			
4900	9.091	62.711	26.458	177.640			
5000	9.139	62.895	27.185	178.551			
5100	9.185	63.076	27.886	179.467			
5200	9.226	63.255	28.565	180.388			
5300	9.265	63.431	29.221	181.313			
5400	9.300	63.605	29.856	182.241			
5500	9.332	63.775	30.471	183.172			
5600	9.361	63.944	31.068	184.107			
5700	9.387	64.110	31.646	185.045			
5800	9.409	64.273	32.207	185.984			
5900	9.429	64.434	32.752	186.926			
6000	9.446	64.593	33.282	187.870			

15 March 1963

HLS

0°K to 2125°K
2125°K to 4644.05°K
4644.05°K to 6000°K

Crystal
Liquid
Ideal Monatomic Gas

$\Delta H_{f0}^{\circ} = 0$	$\Delta H_{f298.15}^{\circ} = 0$
$\Delta H_{298.15}^{\circ} = 143.126 \text{ Kcal gfw}^{-1}$	$S_{298.15}^{\circ} = 9.29 \text{ cal degK}^{-1} \text{ gfw}^{-1}$
$T_t = 1135^{\circ}\text{K}$	$\Delta H_t = 0.915 \text{ Kcal gfw}^{-1}$
$T_m = 2125^{\circ}\text{K}$	$\Delta H_m = 4.900 \text{ Kcal gfw}^{-1}$
$T_b = 4644.05^{\circ}\text{K}$	$\Delta H_v = 135.454 \text{ Kcal gfw}^{-1}$
$H_{298.15}^{\circ} - H_0^{\circ} = 1.313 \text{ Kcal gfw}^{-1}$	
$C_p^{\circ} = 6.50 + 1.42 \times 10^{-3}T - 0.82 \times 10^{-5}T^{-2} \text{ cal degK}^{-1} \text{ gfw}^{-1}$	$298.15^{\circ}\text{K} \leq T \leq 1135^{\circ}\text{K}$
$C_p^{\circ} = 7.900 \text{ cal degK}^{-1} \text{ gfw}^{-1}$	$1135 \leq T \leq 2125^{\circ}\text{K}$
$C_p^{\circ} = 8.00 \text{ cal degK}^{-1} \text{ gfw}^{-1}$	$2125 \leq T \leq 4644^{\circ}\text{K}$

Structure

h. c. p. to 1135°K, b. c. c. from 1135°K to melting point

Heat of Formation

Zero by definition.

Heat Capacity and Entropy

Low temperature data from Skinner and Johnston ¹ High temperature data from Kelley ²

Melting

Temperature of transition point and heat of transition from Kelley ² Heat of fusion from Kelley. ² Melting temperature from Hultgren et al ³

Heat of Sublimation

An average of the data by Trulson and Goldstein ⁴ and Skinner et al ⁵

References

- 1 Skinner, G B and H L Johnston, J Am. Chem. Soc. 73, 4549 (1951)
- 2 Kelley, K K, Bur Mines. Bull. 584 (1960)
- 3 Hultgren, R et al, Selected Values, U of California, Berkeley (1960)
- 4 Trulson, O C and H W Goldstein, Union Carbide Quarterly Progress Rept., Contract DA-30-069-2787 (31 March 1962).
- 5 Skinner, G B, J W Edwards and H L Johnston, J Am. Chem Soc 73, 174 (1951)

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	$\frac{\text{cal/}^{\circ}\text{K gfw}}{C_p^{\circ} \quad H_T^{\circ} \quad -(F_T - H_{298}^{\circ})/T}$			$\frac{\text{Kcal/gfw}}{H_T^{\circ} - H_{298}^{\circ} \quad \Delta H_f^{\circ} \quad \Delta F_f^{\circ}}$			Log K _p
298.15	± 0.050	± 0.040	± 0.040	± 0.000			
1000	± 0.500	± 0.123	± 0.065	± 0.058			
1135	± 0.500	± 0.185	± 0.077	± 0.123			
1135	± 0.500	± 0.273	± 0.077	± 0.223			
2000	± 1.000	± 0.569	± 0.229	± 0.680			
2125	± 1.000	± 0.625	± 0.251	± 0.796			
2125	± 2.000	± 0.860	± 0.251	± 1.296			
3000	± 2.000	± 1.550	± 0.535	± 3.046			
4000	± 2.000	± 2.125	± 0.864	± 5.046			
4644.05	± 2.000	± 2.465	± 1.088	± 6.532			
4644.05	± 0.002	± 0.004					
5000	± 0.002	± 0.004					
6000	± 0.001	± 0.004					

TABLE 250

ZIRCONIUM

IDEAL MONATOMIC GAS

Zr

Reference State for Calculating ΔH_f° , ΔF_f° , and $\log K_p$: Solid Zr from 0° to 2125°K,
Liquid Zr from 2125° to 4644°K, Gaseous Zr from 4644° to 6000°K.

T, °K	C_p	S_T°	$-(F_T^\circ - H_{298}^\circ)/T$	$H_T^\circ - H_{298}^\circ$	ΔH_f°	ΔF_f°	$\log K_p$
0	0.000	0.000	INFINITE	-1.629	142.810	142.810	INFINITE
298.15	6.368	43.317	43.317	0.000	143.126	132.981	-97.473
300	6.375	43.356	43.317	0.012	143.127	132.918	-96.826
400	6.612	45.231	43.571	0.664	143.148	129.511	-70.758
500	6.594	46.707	44.056	1.326	143.137	126.102	-55.117
600	6.464	47.899	44.601	1.979	143.089	122.700	-44.691
700	6.316	48.884	45.144	2.618	143.005	119.308	-37.248
800	6.199	49.719	45.665	3.243	142.888	115.930	-31.669
900	6.133	50.445	46.157	3.859	142.745	112.568	-27.334
1000	6.121	51.090	46.619	4.472	142.582	109.224	-23.870
1100	6.156	51.675	47.052	5.085	142.403	105.897	-21.039
1135	6.177	51.868	47.198	5.301	142.339	104.736	-20.166
1135	6.177	51.868	47.198	5.301	141.424	104.736	-20.166
1200	6.226	52.713	47.460	5.704	141.313	102.638	-18.692
1300	6.320	52.715	47.845	6.331	141.150	99.423	-16.714
1400	6.428	53.188	48.210	6.969	140.998	96.218	-15.020
1500	6.542	53.635	48.557	7.617	140.856	93.024	-13.553
1600	6.655	54.061	48.888	8.277	140.75	89.840	-12.271
1700	6.764	54.468	49.204	8.948	140.607	86.664	-11.141
1800	6.866	54.857	49.507	9.629	140.498	83.494	-10.137
1900	6.960	55.231	49.799	10.321	140.400	80.329	-9.240
2000	7.047	55.590	50.080	11.021	140.310	77.168	-8.432
2100	7.128	55.936	50.350	11.730	140.229	74.015	-7.702
2125	7.148	56.020	50.416	11.909	140.211	73.228	-7.531
2125	7.148	56.020	50.416	11.909	135.311	73.228	-7.531
2200	7.204	56.269	50.612	12.447	135.249	71.036	-7.056
2300	7.276	56.591	50.865	13.171	135.173	68.118	-6.472
2400	7.345	56.902	51.110	13.902	135.104	65.205	-5.937
2500	7.413	57.204	51.348	14.640	135.042	62.294	-5.445
2600	7.481	57.496	51.578	15.384	134.986	59.388	-4.992
2700	7.549	57.779	51.803	16.136	134.938	56.478	-4.571
2800	7.618	58.055	52.021	16.894	134.896	53.574	-4.181
2900	7.688	58.323	52.234	17.659	134.861	50.671	-3.818
3000	7.760	58.585	52.441	18.432	134.834	47.768	-3.480
3100	7.833	58.841	52.644	19.212	134.814	44.865	-3.163
3200	7.908	59.091	52.841	19.999	134.801	41.964	-2.866
3300	7.984	59.335	53.034	20.793	134.791	39.064	-2.587
3400	8.061	59.575	53.223	21.595	134.797	36.162	-2.324
3500	8.139	59.810	53.408	22.405	134.807	33.261	-2.077
3600	8.217	60.040	53.589	23.223	134.825	30.360	-1.843
3700	8.294	60.266	53.767	24.049	134.851	27.457	-1.622
3800	8.371	60.488	53.941	24.882	134.884	24.551	-1.412
3900	8.447	60.707	54.111	25.723	134.925	21.653	-1.213
4000	8.522	60.922	54.279	26.571	134.973	18.746	-1.024
4100	8.595	61.133	54.443	27.427	135.029	15.842	-0.844
4200	8.666	61.341	54.605	28.290	135.092	12.930	-0.673
4300	8.735	61.546	54.764	29.160	135.162	10.024	-0.509
4400	8.802	61.747	54.921	30.037	135.239	7.109	-0.353
4500	8.865	61.946	55.075	30.921	135.323	4.198	-0.204
4600	8.926	62.141	55.226	31.810	135.412	1.285	-0.061
4644.05	8.952	62.226	55.292	32.204	135.454	0.001	0.000
4644.05	8.952	62.226	55.292	32.204			
4700	8.984	62.334	55.375	32.706			
4800	9.039	62.524	55.522	33.107			
4900	9.091	62.711	55.667	33.514			
5000	9.139	62.895	55.810	33.925			
5100	9.185	63.076	55.950	36.341			
5200	9.226	63.255	56.089	37.262			
5300	9.265	63.431	56.226	38.187			
5400	9.300	63.605	56.361	39.115			
5500	9.332	63.775	56.494	40.046			
5600	9.361	63.944	56.626	40.981			
5700	9.387	64.110	56.756	41.919			
5800	9.409	64.273	56.884	42.858			
5900	9.429	64.434	57.011	43.800			
6000	9.446	64.593	57.136	44.744			

15 March 1963

HLS

$$\Delta H_{f0}^{\circ} = 142.810 \text{ Kcal gfw}^{-1}$$

Ground State Configuration 3F_2

$$H_{298.15}^{\circ} - H_0^{\circ} = 1.629 \text{ Kcal gfw}^{-1}$$

$$\Delta H_{f298.15}^{\circ} = 143.126 \text{ Kcal gfw}^{-1}$$

$$S_{298.15}^{\circ} = 43.317 \text{ cal degK}^{-1} \text{ gfw}^{-1}$$

Electronic Levels and Multiplicities

All levels from Moore.¹

Heat of Formation

An average heat of formation based on the work of Trulson and Goldstein² and Skinner et al³ was used.

Heat Capacity and Entropy

Calculated using monatomic gas program.

References

1. Moore, C., Atomic Energy Levels, Vol. 2 (1952).
2. Trulson, O. C. and H. W. Goldstein, in Union Carbide Quarterly Progress Rept. by Lowrie et al under Contract DA-30-069-2787 (31 March 1962).
3. Skinner, G. B., J. W. Edwards and H. L. Johnston, J. Am. Chem. Soc. 73, 174 (1951).

ZIRCONIUM, MONATOMIC (Zr)

(IDEAL GAS)

GFW = 91.22

SUMMARY OF UNCERTAINTY ESTIMATES

T, °K	cal/°K gfw			Kcal/gfw			Log K _p
	C _p ^o	S _T ^o	-(F _T ^o - H ₂₉₈ ^o)/T	H _T ^o - H ₂₉₈ ^o	ΔH _f ^o	ΔG _f ^o	
298.15	± 0.001	± 0.002	± 0.003	± 0.000	± 0.000	± 0.000	
1000	± 0.001	± 0.002	± 0.003	± 0.000	± 0.000	± 0.000	
1135	± 0.001	± 0.002	± 0.003	± 0.000	± 0.000	± 0.000	
1135	± 0.001	± 0.002	± 0.003	± 0.000	± 0.000	± 0.000	
2000	± 0.001	± 0.003	± 0.003	± 0.003	± 0.001	± 0.001	
2125	± 0.001	± 0.003	± 0.003	± 0.003	± 0.001	± 0.001	
2125	± 0.001	± 0.003	± 0.003	± 0.003	± 0.001	± 0.001	
3000	± 0.002	± 0.003	± 0.003	± 0.003	± 0.002	± 0.002	
4000	± 0.002	± 0.003	± 0.003	± 0.003	± 0.003	± 0.003	
4644.05	± 0.002	± 0.004	± 0.003	± 0.003	± 0.005	± 0.005	
5000	± 0.002	± 0.004	± 0.003	± 0.003	± 0.005	± 0.005	
6000	± 0.001	± 0.004	± 0.003	± 0.003	± 0.006	± 0.006	

VIII
BIBLIOGRAPHY

BIBLIOGRAPHY AND PROPERTY FILE

This document, volume 2, provides a key to much thermodynamic and related literature for refractories of interest. A bibliography (section VIII) and subject or property file (section IX) are included herein. The present bibliography has been utilized in the work reported in volume 1 (Discussion) and volume 2 (Thermodynamic Tables).

Basically, the present bibliography has been compiled by finding pertinent references for 35 elements, and their borides, carbides, nitrides, and oxides. The elements of interest include: beryllium, boron, calcium, carbon, cerium, chromium, dysprosium, gadolinium, hafnium, iridium, lanthanum, magnesium, manganese, molybdenum, niobium, nitrogen, neodymium, osmium, oxygen, platinum, rhenium, rhodium, samarium, scandium, silicon, strontium, tantalum, technetium, thorium, titanium, tungsten, uranium, vanadium, yttrium, and zirconium.

The manner of compiling this bibliography has been described in section IIB of volume 1. For complete information, that section should be consulted. Many abstracting sources have been utilized. The literature available through October 1963 Chemical Abstracts has been included herein.

The authors are well aware of many deficiencies of the present work, and no claim is made for completeness. An earlier bibliography¹ can be consulted for further references. There may be a small amount of duplication of that earlier work by this work, but in general this is not expected to be too large. The references cited in this bibliography may often contain data of a nonthermodynamic nature. However, if it appeared that the article might provide useful complementary material, it was included. Also, in some cases, data for compounds of not immediate interest have been included because of their relationships to compounds which are of interest.

It is felt that the present bibliography can provide a good basis for the investigation of thermodynamic properties of the given compounds. However, the careful worker who wants a very complete bibliography must expect to delve deeper by further cross referencing, by usage of abstract indexes, etc. For example, in the analyses of volume 1, many references have been discovered which are not in the bibliography.

¹Barriault, R. J. et al, ASD TR 61-260, Pt. I, Vol. 2 (May 1962).

Manuscript released by authors (December 1963) for publication as an ASD Technical Documentary Report.

In utilizing the present bibliography, one normally should consult the subject or property file (section IX) first. A given compound is listed in column ②, of this file, by the usual chemical formula arranged alphabetically. Once, a particular compound has been found, desired properties can be selected from column ①. In this column, a mnemonic code has been used. For codes which are not immediately obvious, one can consult the property-file-code sheet at the beginning of section IX. After a desired reference is located in the property or subject file of section IX, it can then be located in the alphabetic or main bibliography of section VIII. To locate it there, one uses the information in the last three columns (③, ④, ⑤) of the property file of section IX. Usually, the author's name will be sufficient, but the year information and the code number in the last column provide the positive identification of a particular reference.

- Column ① - identifies the left-most column in heavy print on the first, alternate lines for a given reference. It refers to SPK, THER, THER, TRT, etc., on the sample page of the property file.
- Column ② - identifies the second or right-most column, in light print on the first, alternate lines for a given reference. It refers to TC, TC, etc., on the sample page of the property file.
- Column ③ - identifies the left-most column in light print on the second, alternate lines for a given reference. It refers to SHADMI, SCHICK, MARGRAVE, etc., on the sample page of the property file.
- Column ④ - identifies the middle column in heavy print in the second, alternate lines for a given reference. It refers to the last two digits of the year of publication, e.g. 61, 62, 61, etc.
- Column ⑤ - identifies the serial number on the right-most column on the second, alternate lines for a given reference. On the sample page of the property file, it is illustrated as 700954, 300995, 700967, etc.

ABRAHAMS, S	201991
MAGNETIC AND CRYSTAL STRUCTURE OF TITANIUM SESQUIOXIDE	201991
PHYS REV 130, 2230 (1963)	201991
ABRIKOSOV, N LIANG, T SHASKHOV, Y	300848
VOLATILITY OF BORON OXIDE IN HELIUM AND HYDROGEN IN THE	300848
PRESNCE OF WATER VAPOR	300848
IZVEST A N SSSR OTN MET TOP 1960, NO 4, 156 (1960)	300848
CA 55, 11005 (1961)	300848
ABSHIRE, E NOTESTINE, S	600649
BIBLIOGRAPHY OF HAFNIUM	600649
BM-IC-7928 (1960)	600649
NS 15, 517 (1961)	600649
ACKERMANN, R	601262
VAPOR PRESSURE OF THORIA	601262
J AM CHEM SOC 78, 1767 (1956)	601262
NSA 10, 7489 (1956)	601262
ACKERMANN, R	601322
(ARGONNE NATL LAB LEMONT ILL)	601322
HIGH-TEMP-THERMODYNAMIC PROPERTIES OF UO2	601322
J CHEM PHYS 25, 1089 (1956)	601322
NSA 11, 2880 (1957)	601322
ACKERMANN, R	601273
THE HIGH-TEMPERATURE, HIGH VACUUM VAPORIZATION	601273
AND THERMODYNAMIC PROPERTIES OF UO2	601273
ANL-5482	601273
NSA 9, 7981 (1955)	601273
ACKERMANN, R GILLES, P THORN, R	601045
(UNIV KANSAS LAWRENCE KANSAS)	601045
HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF URANIUM DIOXIDE	601045
J CHEM PHYS 25, 1089 (1956)	601045
CA 51, 5526 (1957)	601045
ACKERMANN, R GILLES, P THORN, R	601078
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF URANIUM DIOXIDE	601078
J CHEM PHYS 29, 237 (1958)	601078
CA 52, 17936 (1958)	601078
ACKERMANN, R RAUH, E	700840
(ARGONNE NATL LAB LEMONT ILL)	700840
VAPOR PRESSURES OF SCANDIUM, YTTRIUM AND LANTHANUM	700840
J CHEM PHYS 36, 448 (1962)	700840
NUCL SCI ABSTR 16, 10003 (1962)	700840
ACKERMANN, R RAUH, E THORN, R	601685
EFFECT OF OXYGEN ON THE VAPOR PRESSURE OF URANIUM	601685
JOURNAL OF CHEM PHYS 37, 2693 (1962)	601685
BHT NO 4 (1962)	601685
ACKERMANN, R J RAUH, E G THORN, R J	301164
CANNON, M C	301164
(ARGONNE NAT LAB ARGONNE ILL)	301164
(UTAH STATE UNIV LOGAN UTAH)	301164
A THERMODYNAMIC STUDY OF THE THO2 SYSTEM AT HIGH TEMPERATURES	301164
J PHYS CHEM 67, 762 (1963)	301164
BHT NO 2, 27 (1963)	301164
ACKERMANN, R THORN, R	300255

HIGH TEMPERATURE VAPORIZATION OF INORGANIC SUBSTANCES	ENTROPY	300255
CONSIDERATIONS		300255
CONG INTERN CHIM ET PURE APPL 16 (1957)	MEM SECT CHIM MINERALE	300255
609-14 PUB (1958)		300255
CA 54, 8261 (1960)		300255
ACKERMANN, R THORN, R		601087
REACTIONS YIELDING VOLATILE OXIDES AT HIGH TEMPERATURES		601087
FREE ENERGIES OF GASEOUS AL ₂ O ₃ , ZrO ₂ , ThO ₂ , Ta ₂ O ₅ , ZrO ₂ , ThO ₂ , Ta ₂ O ₅ , UO ₂ , AND W ₂ O ₃		601087
U S ATOMIC ENERGY COMM ANL 5824, 24 (1958)		601087
CA 52, 12533 (1958)		601087
ACKERMANN, R THORN, R		601174
(ARGONNE NAT LAB LEMONT ILL)		601174
FREE ENERGIES OF FORMATION OF GASEOUS URANIUM, MOLYBDENUM		601174
AND TUNGSTEN TRIOXIDES		601174
J PHYS CHEM 64, 350 (1960)		601174
CA 54, 17030 (1960)		601174
ACKERMANN, R THORN, R		601208
HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF REACTOR		601208
MATERIALS		601208
PROC U N INTERN CONF PEACEFUL USES AT ENERGY 2ND GENEVA		601208
28, 180 (1958)		601208
CA 54, 1056 (1960)		601208
ACKERMANN, R THORN, R		700908
VAPORIZATION OF OXIDES		700908
PROGRESS IN CERAMIC SCIENCE I, 39 (1961)		700908
NSA 15, 26061 (1961)		700908
ACKERMANN, R THORN, R		601510
(ARGONNE NATL LAB LEMONT ILL)		601510
REACTIONS YIELDING VOLATILE OXIDES AT HIGH TEMPERATURES		601510
FREE ENERGIES OF GASEOUS AL ₂ O ₃ , ZrO ₂ , ThO ₂ , Ta ₂ O ₅ , ZrO ₂ , ThO ₂		601510
Ta ₂ O ₅ , V ₂ O ₅ AND W ₂ O ₃		601510
ANL-5824 (1958)		601510
NSA 12, 5209 (1958)		601510
ACKERMANN, R THORN, R		601616
(ARGONNE NATL LAB LEMONT ILL)		601616
VAPORIZATION PROPERTIES OF THORIUM, URANIUM,		601616
AND PLUTONIUM METALS AND OXIDES		601616
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,		601616
PROC, VIENNA, MAY 1962		601616
NSA 16, 25400 (1962)		601616
ACKERMANN, R THORN, R		601615
THERMODYNAMIC PROPERTIES OF COMPOUNDS OF		601615
ACTINIDE ELEMENTS		601615
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,		601615
PROC, VIENNA, MAY 1962		601615
NSA 16, 25398 (1962)		601615
ACKERMANN, R THORN, R GILLES, P		600983
(ARGONNE NAT LAB LEMONT ILL)		600983
VAPOR PRESSURE OF THORIA		600983
J AM CHEM SOC 78, 1767 (1956)		600983
CA 50, 9811 (1956)		600983
ACKERMANN, R THORN, R WINSLOW, G		301391
(ARGONNE NATL LAB LEMONT ILL)		301391

FUNDAMENTAL ASPECTS OF VAPORIZATION U S AT ENERGY COMM ANL 6663, 27 (1962) CA 58, 11971 (1963)	301391 301391 301391
ACKERMANN, R THORN, R WINSLOW, G SYSTEMATIC TRENDS IN VAPORIZATION AND THERMODYNAMIC PROPERTIES OF OXIDES PLANETARY AND SPACE SCIENCE 3, 12 (1961)	700580 700580 700580 700580
ACKET, G A VOLGER, J (RIJKS UNIV UTRECHT NETHERLANDS) MEASUREMENTS OF THE BULK CONDUCTIVITY OF SLIGHTLY REDUCED RUTILE (TiO ₂) PARALLEL AND PERPENDICULAR TO THE C-AXIS PHYSICA 29, 225 (1963) CA 59, 2249C (1963)	301165 301165 301165 301165 301165
ADAM, J ROGERS, M (AT ENERGY RES ESTAB HARWELL ENGLAND) THE CRYSTAL STRUCTURE OF ZrO ₂ AND HfO ₂ ACTA CRYST 12, 951 (1959) CA 55, 26605 (1961)	300852 300852 300852 300852 300852
ADAMS, M THERMAL CONDUCTIVITY III, PROLATE SPHEROIDAL ENVELOPE METHOD DATA FOR AL ₂ O ₃ , BeO, MgO, ThO ₂ , ZrO ₂ J AM CERAM SOC 37, 74 (1954) CA 48, 4788 (1954) NSA 8, 2416 (1954)	600961 600961 600961 600961 600961 600961
ADAMS, M JACOB, L ELECTRICAL CONDUCTIVITY OF STRONTIUM OXIDE NATUR 188, 130 (1960) CA 55, 6147 (1961)	200763 200763 200763 200763
AFAF, M BAND SPECTRUM OF ZIRCONIUM OXIDE PROC PHYS SOC 63A, 1156 (1950) CA 45, 2774 (1951)	600914 600914 600914 600914
AFANASYEV, A THE FOURTH UKRAINIAN CONFERENCE ON PHYSICAL CHEMISTRY UKRAIN KHIM ZHUR 27, 4 (1961)	400603 400603 400603
AFENKOV, N APPLICATION OF THE LAW OF CORRESPONDING STATES TO THE COMPRESSIBILITY AND HEAT CAPACITY OF LIQUIDS IZV VYSSHIKH UCHEBN ZAVEDENII KHIM TEKNOL 5, 672 (1962) CA 58, 1920 (1963)	301392 301392 301392 301392 301392
AGEEV, N KARPINSKII, O PETROVA, L THE MECHANISM OF DECOMPOSITION OF THE B-SOLID SOLUTION OF FUSIONS OF TITANIUM WITH RHENIUM ZH NEORGAN KHIM 6, 251 (1961) CA 57, 6862 (1962)	201762 201762 201762 201762 201762
AGEEV, N KOPETSKII, C REACTION OF THE VII-A SUBGROUP ELEMENTS WITH TRANSITION METALS DOKLADY AKAU NAUK SSSR 129, 559 (1959) CA 56, 1124 (1962)	201230 201230 201230 201230 201230
AGGARWAL, P GOSWAMI, A A NEW PHASE STRUCTURE OF MOLYBDENUM	700514 700514

PROC PHYS SOC (LONDON) 70B, 708 (1957)	700514
CA 52, 12502 (1958)	700514
AGLADZE, R MANPØRIUYA, G	700551
THERMAL STABILITY ØF NITRIDED ELECTROLYTIC MANGANESE	700551
ZHUR PRIKLAD KHIM 34, 345 (1961)	700551
AGTE, C BLUM, G	300342
TITANIUM CARBIDE-BASED HIGH TEMPERATURE MATERIALS	300342
NEUE HUTTE VI, 139 (1961)	300342
CØTS 46, 104 (1961)	300342
AHEARN, A THURMØND, C	300471
MASS-SPECTROGRAPHIC DETECTION ØF MOLECULAR SPECIES IN	300471
GRØUP III-V CØMPØUNDS	300471
J PHYS CHEM 66, 575 (1962)	300471
BHTG NØ 4, 13 (1962)	300471
AINSLIE, N MACKENZIE, J TURNBULL, D	600837
MELTING KINETICS ØF QUARTZ AND CRISTØBALITE	600837
J PHYS CHEM 65, 1718 (1961)	600837
AKERLIND, L	300610
RØTATIONAL ANALYSIS ØF THE RED AND GREEN-YELLØW SYSTEMS ØF	300610
LANTHANUM ØXIDE	300610
ARK FYS (SWEDEN) 22, 65 (1962)	300610
PA 65, 10247 (1962)	300610
AKERLIND, L	300611
RØTATIONAL ANALYSIS ØF THE BLUE-GREEN AND ØRANGE SYSTEMS ØF	300611
SCANDIUM ØXIDE	300611
ARK FYS (SWEDEN) 22, 41 (1962)	300611
PA 65, 10246 (1962)	300611
AKERLIND, L	700635
RØTATION ANALYSIS ØF THE BAND SYSTEM ØF SCANDIUM ØXIDE	700635
NATURWISSENSCHAFTEN 48, 375 (1961)	700635
CT NØ 13, (1961)	700635
AKERLIND, L	700894
(UNIV STØCKHØLM STØCKHØLM 6EDE58	700894
RØTATION ANALYSIS ØF THE BAND SYSTEMS ØF LANTHANUM ØXIDE	700894
NATURWISS 49, 7 (1962)	700894
CA 57, 1754 (1962)	700894
AKHACHINSKIY, V KØPYTIN, L	301104
HEATS ØF FØRMATION ØF INTERMETALLIC CØMPØUNDS ØF PU WITH AI	301104
AND FE AND ØF U WITH FE	301104
SYMPOSIUM ØN THERMØDYNAMICS ØF NUCLEAR MATERIALS, VIENNA (1962)	301104
AEC-TR-5451	301104
AKIMØV, A	601099
ARC AND SPARK SPECTRA ØF GADØLINIUM DYSPRØSIUM ERBIUM AND	601099
THULIUM IN THE ALTERNATING CURRENT ARC	601099
ØPTIKA I SPEKTRØSKØPIYA 3, 545 (1957)	601099
CA 52, 6919 (1958)	601099
AKISHIN, P KHØDEEV, Y	300453
DETERMINATION ØF HEAT ØF SUBLIMATION ØF URANIUM	300453
TETRAFLUØRIDE BY THE MASS SPECTROMETRIC METHØD	300453
ZHUR FIZ KHIM 35, 1169 (1961)	300453
BHTG NØ 4, 2 (1962)	300453

AKISHIN, P KHODEEV, Y	300592
MASS SPECTROMETRIC STUDY OF THE COMPOSITION OF VAPOR	300592
OVER ZR, TI, AND BORON NITRIDES	300592
ZHUR NEORG KHIM 1 NO 4, 941 (1962)	300592
RUSS ACC 15, NO 4, 1214 (1962)	300592
AKISHIN, P NAURMOV, V	201201
(M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	201201
AN ELECTROGRAPHIC STUDY OF THE STRUCTURE OF GASEOUS	201201
SCF3 AND THE ESTIMATION OF SCANDIUM HALOGEN DISTANCES	201201
IN SCCL3, SCBR3 AND SCI3	201201
ZHUR STRUKT KHIM 2, 3 (1961)	201201
CA 56, 91 (1962)	201201
AKISHIN, P NIKITIN, O GOROKHOV, L	300352
DETERMINATION OF THE HEAT OF SUBLIMATION OF BORON BY THE	300352
MASS-SPECTROSCOPIC METHOD	300352
DOKLADY A N SSSR 129, 1075 (1959)	300352
CA 56, 1005 (1962)	300352
AKISHIN, P A VILKOV, L V ZASORIN, E Z RAMBIDI, N G	301167
SPIRIDONOV, V P	301167
(STATE UNIV MOSCOW RUSSIA)	301167
ELECTRON-DIFFRACTION STUDY OF THE MOLECULAR STRUCTURE OF SOME	301167
GASEOUS OXIDES	301167
J PHYS SOC JAPAN 17 SUPPL B-II 18 (1962)	301167
CA 59, 4609G (1963)	301167
AKRAM, K SMELTZER, W	201872
THE HIGH TEMPERATURE OXIDATION KINETICS OF ZIRCONIUM	201872
CAN MET QUART 1, NO 1, 41 (1962)	201872
CA 57, 13212 (1962)	201872
ALBERMAN, K ANDERSON, J	400538
THE OXIDES OF URANIUM	400538
J CHEM SOC 1949, 2, 303 (1949)	400538
CA 44, 8755 (1950)	400538
NSA 4, 4277 (1950)	400538
ALBERTSON, W	900122
THE SPECTRUM OF NEUTRAL IRIIDIUM IR1	900122
PHYS REV 54, 183 (1938)	900122
ALCOCK, C GRIFVESON, P	601606
STUDY OF URANIUM BORIDES AND CARBIDES	601606
BY MEANS OF THE KNUDSEN EFFUSION TECHNIQUE	601606
IAEA SYMP PROC-VIENNA (1962)	601606
NSA 16, 35375 (1962)	601606
ALCOCK, C HOPPER, G	601161
THERMODYNAMICS OF GASEOUS OXIDES OF THE PLATINUM GROUP METALS	601161
PROC ROY SOC (LONDON) 254, 551 (1960)	601161
CA 54, 23694 (1960)	601161
ALDRED, F	201993
(MORGAN REFRACTORIES LTD NESTON ENGLAND)	201993
ALUMINA CERAMICS	201993
TRANS BRIT CERAM SOC, 61 705 (1962)	201993
CA 58, 8746 (1963)	201993
ALEKSANDROVSKAYA, A ALEKSEYANKOVA, Y SINITSYNA, L GODNEV, I	201610
(CHEM-TECHNOL INST IVANOV RUSSIA)	201610
THERMODYNAMIC FUNCTIONS OF GASEOUS SILICON TETRAIODIDE	201610

AND ZIRCONIUM TETRAOXIDE	201610
IZV VYSSHIKH UCHEBN ZAVEDENII, KHIM I KHIM TEKHNOL 5, NO 1,	201610
171 (1962)	201610
CA 57, 2925 (1962)	201610
ALEKSEEV, V I SHVARTSMAN, L A	301168
THERMODYNAMICS OF REACTIONS OF TUNGSTEN CARBIDE FORMATION	301168
IZV A N SSSR O TIN MET I GORM DELO 1963, 1 91	301168
CA 58, 10793D (1963)	301168
ALEKSANDROVSKAYA, A GODNEV, I SVERDLIN, A	301393
(CHEM TECHNOL INST IVANOV O SSSR)	301393
THERMODYNAMIC FUNCTIONS OF HAFNIUM HALIDES	301393
CA 59, 3367 (1963)	301393
ALEKSEEV, V SHVARTSMAN, L	300846
FREE ENERGY OF FORMATION OF MOLYBDENUM CARBIDE	300846
IZV A N SSSR OTD TEKHN NAUK MET I TOPLIVO	300846
1962, NO 6, 171 (1962)	300846
ALEKSEEVA, V SHVARTSMAN, L	600909
EQUILIBRIUM IN THE SYSTEM V2C-H2-CH4-V	600909
DOKLADY AKAD NAUK SSSR 133, 1331 (1960)	600909
CA 55, 12018 (1961)	600909
ALEKSEEVA, V SHVARTSMAN, L	700632
FREE ENERGY OF FORMATION OF SOME VANADIUM AND CHROMIUM CARBIDE	700632
FIZ METAL I METALLOVED AKAD NAUK SSSR 11, 545 (1961)	700632
CT NO 12, (1961)	700632
CA 55, 26636 (1961)	700632
ALEKSEYEVSKIY, N	400600
HIGH RESOLVING MASS-SPECTROMETER	400600
VEST AK NAUK SSSR 6, 67 (1958)	400600
ALLENARD, S	201402
TWO NEW MANGANESE BORIDES OBTAINED BY FUSION ELECTROLYSIS	201402
COMPT REND 253, 1213 (1961)	201402
CA 56, 8457 (1962)	201402
ALEXANDER, C	300533
VAPOR-SOLID EQUILIBRIA IN THE URANIUM OXIDE-OXYGEN SYSTEM	300533
DISS ABST 22, NO 11, 3864 (1961)	300533
BHT NO 2, 28 (1962)	300533
ALEXANDER, C SHEVIN, T	201921
(BATTELLE MEMORIAL INST COLUMBUS OHIO)	201921
URANIUM OXIDE PRESSURE-TEMPERATURE-COMPOSITION RELATIONSHIPS	201921
FROM 1000 TO 2000 DEGREE K	201921
U S AT ENERGY COMM TID-7622, 139 (1962)	201921
CA 57, 15872 (1962)	201921
ALEXEEV, V SCHVARZMAN, L	300405
FREE ENERGY OF MN23C6	300405
DOKLADY AKAD NAUK SSSR 141, NO 2 346 (1961)	300405
ALLEN, R	600965
URANIUM AND ITS COMPOUNDS BIBLIOGRAPHY OF UNCLASSIFIED	600965
LITERATURE	600965
USAEC TECH INFORM SERVICE, OAK RIDGE, TENN TID-3041, 3 (1953)	600965
CA 48, 2501 (1954)	600965
ALLEN, R GLASIER, L JORDAN, P	200828

SPECTRAL EMISSIVITY, TOTAL EMISSIVITY, AND THERMAL CONDUCTIVITY OF MOLYBDENUM, TANTALUM, AND TUNGSTEN ABOVE 2300 DEGREES K J APPL PHYS 31, 1382 (1960) CA 55, 3199 (1961)	200828 200828 200828 200828 200828
ALLEN, B C MAYKUTH, D J JAFFEE, R I (BATTELLE MEM INST COLUMBUS OHIO THE EFFECT OF IMPURITIES AND STRUCTURE ON THE TENSILE TRANSITION TEMPERATURE OF CHROMIUM TRANS AIME 227, 724 (1963) CA 59, 4865F (1963)	301169 301169 301169 301169 301169 301169
ALLENDORFER, A THE MELTING POINT OF URANIUM Z NATURFORSCH 5A, 234 (1950) CA 44, 8187 (1950) NSA 4, 4870 (1950)	400539 400539 400539 400539 400539
ALMKVIST, G LAGERQVIST, A INFRARED BANDS OF STRONTIUM OXIDE ARKIV FYSIK 1, 477 (1949) CA 44, 3791 (1950)	600922 600922 600922 600922
ALSTAD, J COLVIN, R LEGVOLD, S SPEDDING, F (IOWA STATE UNIV AMES IOWA) ELECTRICAL RESISTIVITY OF LANTHANUM, PRASEODYMIUM, NEODYMIUM AND SAMARIUM PHYS REV 121, 1077 (1961) CA 55, 18228 (1961) NSA 15, 14886 (1961)	201099 201099 201099 201099 201099 201099 201099
ALTMAN, R VAPORIZATION OF MAGNESIUM OXIDE AND ITS REACTION WITH ALUMINA J PHYS CHEM 67, 366 (1963)	300844 300844 300844 300844
ALTUNIN, V (NATL CHEM LAB TEDDINGTON ENGLAND) METHOD OF OBTAINING THE EQUATION OF STATES OF A REAL GAS FROM A LIMITED AMOUNT OF EXPERIMENTAL DATA TEPLØENERGETIKA 9, NO 3, 72 (1962) CA 58, 8418 (1963)	301395 301395 301395 301395 301395 301395
ALYAMOVSKII, S GELD, P MATVEENKO, I (CHEM INST SVERPLOVSK RUSSIA) THE CUBIC PHASES OF VANADIUM CARBIDES ZHUR STRUKT KHIM 2, 445 (1961) CA 56, 8095 (1962)	201374 201374 201374 201374 201374
ALYAMOVSKII, S GELD, P MATVEENKO, I PHASE COMPONENTS OF THE SYSTEM Nb-Si TR URALSK POLITEKHN INST SB 1961, NO 114, 149 CA 57, 533 (1962)	201586 201586 201586 201586
ALYAMOVSKII, S SHVEIKIN, G GELD, P LOWER OXIDES OF NIOBIUM ZHUR NEORGAN KHIM 3, 11, 2436 (1958) RUSSIAN PERIODICAL, ZHUR NEORGAN KHIM 3, 11, 2436 (1958)	400597 400597 400597 400597
AMONENKO, V IVANOV, V TIKHINSKII, G FINKEL, V SHPAGIN, I HIGH TEMPERATURE POLYMORPHISM OF BE FIZ METAL I METALLOVED 12, NO 6, 865 (1961)	300535 300535 300535

BHT NØ 2, 33 (1962)	300535
CA56, 9844 (1962)	300535
AMØNENKØ, V KRUGLYKH, A TIKHINISKII, G	300466
THE VACUUM DISTILLATION ØF CHRØMIUM	300466
UKRAIN FIZ ZHUR 6, 390 (1961)	300466
BHTG NØ 4, 8 (1962)	300466
PA 65, 12936 (1962)	300466
AMØNENKØ, V PAPIRØV, I TIKHINSKII, G FINHEL, V	300585
STUDY ØF WHISKER CRYSTALS ØF BERYLLIUM. PRØDUCTION	300585
ØF WHISKER CRYSTALS AND DETERMINATION ØF THEIR ØRIENTATION	300585
FIZ METAL I METALLØVED 13, NØ 6, 928 (1962)	300585
CT NØ 17, 78 (1962)	300585
AMØNENKØ, V IVANØV, V	301124
X-RAY STUDY ØF THE SØLUBILITY ØF IMPURITIES IN BERYLLIUM	301124
JPRS 17681	301124
CØTS 63, 185 (1963)	301124
AMØNENKØ, V M VASYUTINSKII, B M KARTMAZØV, G N SMIRNØV, Y N	301170
FINKEL, V A	301170
TANTALUM STRUCTURE AT HIGH TEMPERATURES	301170
FIZ METAL I METALLØVED 15, 444 (1963)	301170
CA 59, 1342F (1963)	301170
AMØSØV, V	301125
PRØDUCTION ØF PLASTIC NB FRØM ELECTRØLYTIC PØWDERS	301125
IZV VYSSKIKH UCHEBN ZAVEDENII TSVETN MET 5, 122 (1962)	301125
BHT NØ 1, 29 (1963)	301125
AMØSØV, V LANIS, V	300175
MASS SPECTRØMETRIC INVESTIGATION ØF GAS EVØLUTION PRØCESSES	300175
ACCOMPANYING THE SINTERING ØF TANTALUM AND NIØBIUM	300175
ZHUR PRIK KHIM 34, NØ 1 84 (1961)	300175
MØNTHLY RUSS ACCESSIØNS 242 (1961)	300175
ANDERSON, A	601693
THE STRUCTURE ØF U3Ø8 DETERMINED BY NEUTRØN DIFFRACTION	601693
ACTA CRYST 11, 612 (1958)	601693
CA 52, 17877 (1958)	601693
ANDERSON, E BUCKLEY, R HELLAWELL, A HUME-RØTHERY, W	700975
(UNIV ØF ØXFØRD ØXFØRD ENGLAND)	700975
A DETERMINATION ØF THE MELTING PØINT ØF ELEMENT 43 (TECHNETIUM)	700975
NATURE 188, 48 (1960)	700975
CA 55, 4077 (1961)	700975
NSA 15, 223 (1961)	700975
ANDERSON, E HUME-RØTHERY, W	200969
(UNIV MUSEUM ØXFØRD ENGLAND)	200969
THE EQUILIBRIUM DIAGRAM ØF THE SYSTEM MØLYBDENUM-RHØDIUM	200969
J LESS CØMMØN METALS 2, 19 (1960)	200969
CA 55, 11257 (1961)	200969
ANDERSON, E HUME-RØTHERY, W	201071
THE EQUILIBRIUM DIAGRAM ØF THE SYSTEM MØLYBDENUM-RUTHENIUM	201071
J LESS CØMMØN METALS 2, 443 (1960)	201071
CA 55, 16363 (1961)	201071
ANDERSON, J	301396
(NATL CHEM LAB TEDDINGTON ENGL)	301396
CURRENT PRØBLEMS IN NØNSTØICHIØMETRY	301396

ADVANCEMENT OF CHEMISTRY 39, 1 (1963)	301396
CA 58, 13150 (1963)	301396
ANDERSON, J SAWYER, J WÖRNER, H WILLIS, G BANISTER, M	601172
DECOMPOSITION OF URANIOXIDE AT ITS MELTING POINT	601172
NATURE 185, 915 (1960)	601172
CA 54, 19076 (1960)	601172
ANDERSSON, S	201381
(UNIVERSITY OF STOCKHOLM STOCKHOLM SWEDEN)	201381
THE CRYSTAL STRUCTURE OF TITANIUM	201381
ACTA CHEM SCAND 14, 1161 (1960)	201381
CA 56, 8105 (1962)	201381
ANDES, G HECKEL, R	201498
(E I DUPONT DE NEMOURS AND CO WILMINGTON DEL)	201498
OXIDATION BEHAVIOR OF TUNGSTEN BASE ALLOYS	201498
AM SOCIETY OF METALS, TRANSACTIONS 55, 193 (1962)	201498
CA 56, 12639 (1962)	201498
ANDERSSON, S	201178
(UNIVERSITY OF STOCKHOLM STOCKHOLM SWEDEN)	201178
HOMOLOGOUS SERIES OF MIXED TITANIUM CHROMIUM OXIDES	201178
-Ti(N-2)Cr2O(2N-1) ISOMORPHOUS WITH THE SERIES Ti(N)O(2N-1) AND	201178
V(N)O(2N-1)	201178
ACTA CHEM SCAND 13, 989 (1959)	201178
CA 55, 23150 (1961)	201178
ANDERSSON, S	200845
STRUCTURAL AND GEOMETRIC RELATIONS BETWEEN ALPHA- AND BETA-	200845
TITANIUM, THE W-ALLOY PHASE, DELTA-TITANIUM OXIDE, AND	200845
TITANIUM MONOXIDE	200845
ARKHIV KEMI 15, 247 (1960)	200845
CA 55, 4094 (1961)	200845
ANDREEVA, V ALEKSEEVA, E	201814
OXIDATION OF TITANIUM, ZIRCONIUM, MOLYBDENUM, AND SOME	201814
ALLOYS	201814
ZH PRIKLAD KHM 35, NO 6, 1175 (1962)	201814
CA 57, 9557 (1962)	201814
ANDRES, K	301172
(SWISS FEDERAL INSTITUTE OF TECHNOLOGY ZURICH SWITZERLAND)	301172
GIANT THERMAL EXPANSION COEFFICIENTS IN RARE EARTH METALS AT	301172
LOW TEMPERATURES	301172
PHYSICAL REVIEW LETTERS 10, 223 (1963)	301172
CA 59, 2188 (1963)	301172
ANIKEEV, V LYUBAN, A MANCHINSKII, V	201035
DISSOCIATION AND REDUCTION OF HIGHER OXIDES OF MANGANESES	201035
TRUDY LENINGRAD POLYTECHNICAL INSTITUTE IM MI KALININA 212, 52 (1960)	201035
CA 55, 14216 (1961)	201035
ANITOV, I GORBUNOV, S	700603
RATE OF OXIDATION OF TITANIUM AND ITS ALLOYS IN AIR AT HIGH	700603
TEMPERATURES	700603
ZHUR PRIKLAD KHM 34, 725 (1961)	700603
ANIKINA, L	301173
THE CRYSTAL STRUCTURE OF COESITE	301173
KHM AKADEMIIK SSSR 1960 216, (1962)	301173
CA 57, 14521 (1962)	301173

ANØN			601561
(UNITED KINGDOM AT ENERGY	HARWELL	ENGLAND)	601561
THE PREPARATION AND PROPERTIES OF THE CARBIDES OF SCANDIUM,			601561
YTTRIUM, THE ACTINIDES AND THE LANTHANIDES			601561
AERE-INF/BIB-115 (1958)			601561
NSA 13, 531 (1959)			601561
ANØN			601550
(LOS ALAMOS SCI LAB	LOS ALAMOS	NEW MEX)	601550
CRYSTALLOGRAPHIC DATA NO 177, UN			601550
ANAL CHEM 31, 156 (1959)			601550
NSA 13, 4470 (1959)			601550
ANØN			601507
(ARGONNE NATL LAB	LEMONT	ILL)	601507
METALLURGY DIV QUARTERLY REPT FOR JAN, FEB, MAR 1957			601507
ANL-5717 (1957)			601507
NSA 12, 4824 (1958)			601507
ANØN			601514
(ARGONNE NATL LAB	LEMONT	ILL)	601514
PHYSICS DIV SUMMARY REPT FOR APR THROUGH JUNE 1957			601514
ANL-5754 (1957)			601514
NSA 12, 1580 (1958)			601514
ANØN			601559
(ARGONNE NATL LAB	LEMONT	ILL)	601559
METALLURGY DIV QUARTERLY REPT FOR APR, MAY AND JUN 1957			601559
ANL-5790 (1958)			601559
NSA 13, 1349 (1959)			601559
ANØN			601555
(ARGONNE NATL LAB	LEMONT	ILL)	601555
METALLURGY DIV QUARTERLY REPT FOR JULY, AUG AND SEPT 1957			601555
ANL-5797 (1958)			601555
NSA 13, 2967 (1959)			601555
ANØN			601597
THERMODYNAMIC AND KINETIC STUDIES FOR A REFRACTORY			601597
MATERIALS PROGRAM			601597
ASD-TDR-62-204 PT 1			601597
NSA 16, 25747 (1962)			601597
ANØN			601458
(BROOKHAVEN NATL LAB	LONG ISLAND	NY)	601458
NUCLEAR ENGINEERING DEPT, PROGRESS REPORT, SEPT-DEC 31, 1960			601458
BNL 659			601458
NSA 15, 30331 (1961)			601458
ANØN			601516
(AMES LAB	AMES	IOWA)	601516
TECHNOLOGICAL RESEARCH-METALLURGY PART II OF REPORT FOR			601516
MONTH ENDING OCT 2, 1943			601516
CJ-954 (1957)			601516
NSA 12, 897 (1958)			601516
ANØN			601539
(OFFICE OF TECH SERVICES	WASH	DC)	601539
URANIUM-PART I URANIUM GENERAL 1942-1958			601539
CTR-365			601539
NSA 13, 10120 (1959)			601539
ANØN			601538

(OFFICE OF TECH SERVICES	WASH	DC)	601538
URANIUM-PART II ALLOYS AND COMPOUNDS 1936-1958			601538
CTR-366			601538
NSA 13, 10121 (1959)			601538
ANON			601502
(AMES LAB	AMES	IOWA)	601502
QUARTERLY SUMMARY RESEARCH REPT IN CHEMISTRY			601502
FOR JULY, AUG AND SEPT 1953			601502
ISC-421 (1957)			601502
NSA 12, 706 (1958)			601502
ANON			601501
(AMES LAB	AMES	IOWA)	601501
SEMI-ANNUAL SUMMARY RESEARCH REPT IN CHEM			601501
FOR JAN-JUNE 1957			601501
ISC-902 (1957)			601501
NSA 12, 6438 (1958)			601501
ANON			601524
(AMES LAB	AMES	IOWA)	601524
SEMI ANNUAL SUMMARY RESEARCH REPT IN PHYSICS FOR JULY-DEC 1958			601524
ISC-1115			601524
NSA 13, 18224 (1959)			601524
ANON			601513
(NATL BUR STANDARDS	WASH	DC)	601513
QUARTERLY PROGRESS REPT FOR APR, MAY AND JUNE 1953			601513
NBS-D-124 (1957)			601513
NSA 12, 2022 (1958)			601513
ANON			601549
(UNIV CAL	BERKELEY	CAL)	601549
CHEMISTRY DIVISION SEMIANNUAL REPT FOR DEC 1957-MAY 1958			601549
UCRL-8369 (1958)			601549
NSA 13, 4525 (1959)			601549
ANON			601599
(US BUR MINES	ALBANY	OREGON)	601599
QUARTERLY METALLURGICAL PROG REPT NO 13 OCT 1, 1961			601599
TO DEC 31, 1961			601599
USBM-U-887			601599
NSA 16, 17967 (1962)			601599
ANON			601629
(BUREAU OF MINES	ALBANY	OREGON)	601629
METALLURGICAL PROG REPORT NO 14 FOR THE PERIOD OF			601629
JANUARY 1, 1962 TO MARCH 31, 1962			601629
USBM-U-921			601629
NSA 16, 19374 (1962)			601629
ANON			300229
(POLYTECH INST BROOKLYN	BROOKLYN	NEW YORK)	300229
COMPOUNDS WITH DEFECT LATTICES			300229
QUARTERLY NO 11 (1960) CONTRACT DA36-039 SC 74958			300229
PROJ 3-99-15-110			300229
AD 247864			300229
ANON			300226
STANDARD FREE ENTHALPIES OF FORMATION AT 25 DEGREES			300226
CERELCOR (CENTRE BELGE ETUDE CORROSION)			300226
RAPP TECH NO 87 57 (1960)			300226
CA 55, 13031 (1961)			300226

ANON		300228
(SCI AND TECH SEC AIR INFO WASHINGTON	DC)	300228
THERMODYNAMIC CONSTANTS OF BORON COMBUSTION		300228
ZHUR NEORG KHIM 5, 2141 (1960)		300228
AD 248413 (1961)		300228
ANON		300237
(HIGH TEMP MATS INC BOSTON	MASS)	300237
PYROLYTIC CARBIDE DEVELOPMENT PROGRAM		300237
MONTHLY PROG REPT NO 10 (1961) CONTRACT 60-0292		300237
AD 251504 (1961)		300237
ANON		300239
(RAYTHEON MFG CO WALTHAM	MASS)	300239
HIGH TEMPERATURE MATERIALS DEVELOPMENT		300239
PROG REPT FOR (1961) REPT NO S-252 CONTRACT 19135		300239
CONFIDENTIAL RPT AD-322236 (1961)		300239
ANON		400618
DIAGRAMS OF FREE ENERGY OF CARBIDES VERSUS TEMPERATURE		400618
HUTNICKE LISTY 9, 272 (1954)		400618
ANON		601414
(OAK RIDGE NATL LAB OAK RIDGE	TENN)	601414
PROCEEDINGS OF THE URANIUM CARBIDE MEETING		601414
HELD AT OAK RIDGE NATIONAL LAB (1960)		601414
TID-7603		601414
NSA 15, 19861 (1961)		601414
ANON		601376
AN INVESTIGATION OF SOME RARE EARTH		601376
BORON, CARBON, NITROGEN AND RELATED SYSTEMS		601376
AT ELEVATED TEMPERATURES		601376
TID 692C		601376
NSA 15, 9431 (1961)		601376
ANON		601368
(OFFICE OF TECH SERVICES WASH	DC)	601368
URANIUM-PART I. URANIUM GENERAL, 1942-1958		601368
CTR-365		601368
NSA 14, 1751 (1960)		601368
ANON		601352
(AMES LAB AMES	IOWA)	601352
CHEMISTRY SEMI ANNUAL SUMMARY RESEARCH		601352
REPORT FOR JANUARY-JUNE 1959		601352
IS-15, (1959)		601352
NSA 14, 11488 (1960)		601352
ANON		601349
(NAVAL RES LAB WASH	DC)	601349
NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY OCT-NOV 1959		601349
NSA 14, 11374 (1960)		601349
ANON		600666
(PENN UNIV PHIL	PA)	600666
THERMODYNAMIC PROPERTIES OF METAL CARBIDES AT HIGH		600666
TEMPERATURES		600666
NYO-9625 (1960)		600666
NS 15, 5374 (1961)		600666
ANON		701015

PROGRESS REPORT ON WORK UNDERTAKEN ON PROJECT NO 1 BETWEEN THE UNIVERSITY OF KANSAS AND THE AEC TID-6919 (1960) NSA 15, 11599 (1961)	701015 701015 701015 701015
ARAI, Z HAYASHI, H NAKAMURA, S AZUMA, N FORMATION OF SOLID SOLUTION BETWEEN TITANIUM NITRIDE AND CARBIDE YOGYO KYOKAI SHI 68, 83 (1960) CA 55, 6982 (1961)	200773 200773 200773 200773 200773
ANON NUCLEAR ENG DEPT PROG REPT FOR MAY 1-AUG 1, 1959 (BNL) B N L -583 NSA 14, 17642 (1960)	601337 601337 601337 601337
ANON A NOTE ON THE URANIUM-BORON ALLOY SYSTEM - CORRECTION J INST MET 88, 467 (1960) NSA 14, 23331 (1960)	601328 601328 601328 601328
ANON (AMES LAB AMES IOWA) SEMI-ANNUAL SUMMARY RESEARCH REPT IN PHYSICS FOR JAN THROUGH JUNE 1956 ISC-758 (1956) NSA 11, 4632 (1957)	601319 601319 601319 601319 601319 601319
ANON (BATFLE MEMORIAL INST COLUMBUS OHIO) METALLURGY OF TUBALLOY (URANIUM) CT-2700 (1957) NSA 11, 7662 (1957)	601313 601313 601313 601313 601313
ANON (AMES LAB AMES IOWA) QUARTERLY SUMMARY RESEARCH OCT, NOV, DEC JULY 14, 1955 ISC-575 NSA 11, 7676 (1957)	601312 601312 601312 601312 601312 601312
ANON (NATI BUR STANDARDS WASH DC) QUARTERLY REPT FOR JAN, FEB AND MARCH 1953 DECL FEB 28, 1957 NBS-D-123 NSA 11, 7694 (1957)	601311 601311 601311 601311 601311 601311
ANON (AMES LAB AMES IOWA) SEMI ANNUAL SUMMARY RESEARCH REPT IN PHYSICS FOR JUL THROUGH DEC 1956 ISC-833 (1957) NSA 11, 8117 (1957)	601308 601308 601308 601308 601308 601308
ANON CURRENT BERYLLIUM LITERATURE U S AT ENERGY COMM UCRL 5705, 350 (1963) CA 58, 13531 (1963)	301397 301397 301397 301397
ANON (MASS INST OF TECH CAMBRIDGE MASS) TECHNICAL PROGRESS REPT FOR THE PERIOD OCT 1951	601305 601305 601305

THROUGH MARCH 1952		601305
DECL FEB 28, 1957		601305
MIT-1086		601305
NSA 11, 8517 (1957)		601305
ANØN		601302
(AMES LAB	AMES	IOWA)
HANFORD SLUG PROGRAM SEMI-ANNUAL SUMMARY		601302
RESEARCH REPT FOR JULY-DEC 1956		601302
ISC-837		601302
NSA 11, 9325 (1957)		601302
ANØN		601298
(BUR OF MINES	ALBANY	ØREG)
PROGRESS REPT FOR THE PERIOD OF JULY 15- AUG 15, 1952		601298
NSA 11, 10887 (1957)		601298
ANØN		601297
(AMES LAB	AMES	IOWA)
QUARTERLY SUMMARY RESEARCH REPT IN		601297
METALLURGY FOR APR MAY AND JUNE 1953		601297
DECL FEB 26, 1957		601297
ISC-396 (DEL)		601297
NSA 11, 11703 (1957)		601297
ANØN		601265
(AMES LAB	AMES	IOWA)
QUARTERLY SUMMARY RESEARCH REPT IN CHEM		601265
FOR JAN, FEB, AND MAR, 1955		601265
ISC-606		601265
NSA 10, 4125 (1956)		601265
ANØN		601419
(AMES LAB	AMES	IOWA)
SEMI-ANNUAL SUMMARY RESEARCH REPT IN		601419
METALLURGY FOR JULY-DEC 1956		601419
ISC-835 (1957)		601419
NSA 12, 3680 (1958)		601419
ANØN		700922
MOLYBDENUM AND TUNGSTEN		700922
SB-415 (1960)		700922
NSA 15, 13253 (1961)		700922
ANØN		700932
NUCLEAR FUELS AND MATERIALS DEVELOPMENT		700932
TID-11295 (1961)		700932
NSA 15, 12475 (1961)		700932
ANØN		701022
COLUMBIUM AND TANTALUM		701022
SB-414 (1960)		701022
NSA 15, 13252 (1961)		701022
ANØN		701024
PLATINUM AND ALLIED METALS		701024
SB-420 (1960)		701024
NSA 15, 13254 (1961)		701024
ANØN		500131
(RES CHEM DIV NUCLEAR CORP	PHØENIX	ARIZONA)
PROPERTIES OF YTTRIUM AND THE RARE EARTH METALS		500131
QUARTERLY REPORT APRIL 30, (1961)		500131

REPORT NO RC 182, (CONTRACT AF 33 (616) 6829)	500131
ANON	701047
ZIRCONIUM	701047
SB-464 (SUPPLEMENT TO CTR 344) (1961)	701047
NSA 15, 23859 (1961)	701047
ANON	700715
(ILLINOIS INST OF TECH CHICAGO ILL)	700715
THERMAL AND MECHANICAL PROPERTIES OF BERYLLIA CERAMICS	700715
GA-1906 (1961)	700715
NSA 15, 13342 (1961)	700715
ANON	700716
BERYLLIUM (1945-1960)	700716
SB-413 (1960)	700716
NSA 15, 13251 (1961)	700716
ANSELIN, F PASCARD, R	301126
VOLATILITY OF PUC AND PUN	301126
COMPT REND 225, 698 (1962)	301126
BHT NO 7, 3 (1963)	301126
ANTHONY, R HIMMELBLAU, D	301398
(UNIV OF TEXAS AUSTIN TEXAS)	301398
CALCULATION OF COMPLEX CHEMICAL EQUILIBRIUMS BY SEARCH	301398
TECHNIQUES	301398
J PHYS CHEM 67, 1080 (1963)	301398
CA 58, 13198 (1963)	301398
ANTILL, J	201973
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	201973
OXIDATION OF URANIUM	201973
PROPERTIES REACTOR MATER, EFFECTS RADIATION DAMAGE PROC	201973
INTERN CONF., BERKELEY CASTLE, ENGL, 1961, 379 (1962)	201973
CA 58, 1208 (1963)	201973
ANTILL, J PEAKALL, K	200883
KINETICS OF THE OXIDATION OF URANIUM BY CARBON	200883
DIOXIDE	200883
J LESS COMMON METALS 1, 227 (1959)	200883
CA 55, 6111 (1961)	200883
APPEN, A KAJALOVA, S	300589
SURFACE TENSION OF ALKALI-SILICATE MELTS	300589
DOKLADY AKAU NAUK SSSR 145, NO 3, 592 (1962)	300589
ARADI, A VITANYI, P	201862
(RES INST METAL IND BUDAPEST HUNGARY)	201862
MANUFACTURE OF VANADIUM METAL BY HALOGEN METALLURGY	201862
FEMIP KUT INT KOZLEMEN 5, 283 (1961)	201862
CA 57, 12210 (1962)	201862
ARAI, T	300842
(CARNEGIE INST OF TECH PITTSBURGH PA)	300842
AUTOMATIC COMPUTATION OF ELECTRONIC ENERGIES OF DIATOMIC	300842
MOLECULES	300842
US DEPT COMM OTS PB REPT 148533 (1960)	300842
CA 57, 4048 (1962)	300842
ARAJ, S COLVIN, R	300751
(US STEEL CORP MONROEVILLE PA)	300751
ANALYSIS OF THE SPECIFIC HEATS OF CERIUM, NEODYMIUM,	300751

AND SAMARIUM AT HIGH TEMPERATURES	300751
J LESS COMMON METALS 4, 159 (1962)	300751
CA 57, 4111 (1962)	300751
NSA 16, 16745 (1962)	300751
ARDELL, A	301174
(STANFORD UNIV STANFORD CALIF)	301174
CALCULATION OF MELTING TEMPERATURES FOR LOW-TEMPERATURE	301174
PHASES OF POLYMORPHIC METALS	301174
ACTA MET 11, 591 (1963)	301174
CA 59, 1334 (1963)	301174
ARGENT, B MILNE, G	201039
(UNIV SHEFFIELD SHEFFIELD ENGLAND)	201039
THE PHYSICAL PROPERTIES OF NIOBIUM, TANTALUM, MOLYBDENUM, AND	201039
TUNGSTEN	201039
J LESS COMMON METALS 2, 154 (1960)	201039
CA 55, 14236 (1961)	201039
ARGENT, B PHELPS, B	600611
THE OXIDATION OF NIOBIUM	600611
J INST METALS 88, 301 (1960)	600611
NS 14, 12860 (1960)	600611
ARAMAKI, S ROY, R	201695
(PENN STATE UNIV UNIVERSITY PARK PA)	201695
REVISED PHASE DIAGRAM FOR THE SYSTEM AL ₂ O ₃ -SiO ₂	201695
J AM CERAM SOC 45, 229 (1962)	201695
CA 57, 4340 (1962)	201695
ARIYA, S MOROZOVA, M	300600
EQUILIBRIA BETWEEN VANADIUM OXIDE AND CO ₂ /CO	300600
MIXTURES	300600
ZHUR OBSHCHEI KHIM 32, NO 7, 2081 (1962)	300600
ARIYA, S MOROZOVA, M REIKHARDT, A	600970
(LENINGRAD STATE U LENINGRAD RUSSIA)	600970
THE SYSTEM PLATINUM OXYGEN II ENTHALPY OF PT304	600970
ZHUR OBSHCHEI KHIM 23, 1455 (1953)	600970
CA 48, 4303 (1954)	600970
ARIYA, S POPOV, Y	300599
LATTICE STRUCTURE OF THE LOWER OXIDES OF TITANIUM	300599
AND VANADIUM	300599
ZHUR OBSHCHEI KHIM 32, NO 7, 2077 (1962)	300599
ARIYA, S SOBOLEVA, M	300787
(IZHDANOV LENINGRAD STATE U LENINGRAD RUSSIA)	300787
THE LATTICE ENERGIES OF OXIDES	300787
FIZ TVERDOGO TELA 3, 3157 (1961)	300787
SOVJET PHYSICS SOLID STATE 3, NO 10, 2293 (1962)	300787
PA 65, 8147 (1962)	300787
ARKHAROV, V GFRASIMOV, A NICHKOVA, T	300550
THE OXIDATION OF Nb AT HIGH TEMPERATURES	300550
FIZ METAL I METALLOVED 12, NO 5, 761 (1961)	300550
BHT NO 2, 47 (1962)	300550
CA 56, 8427 (1962)	300550
ARNOLD, H	301175
(MAX PLANCK INST WURZBURG GERMANY)	301175
CRYSTAL STRUCTURE OF QUARTZ HIGH TEMPERATURE FORM	301175
Z KRIST 117, 467 (1962)	301175

BHT NO 2, 11 (1962)	301175
ARONSON, S	200998
(WESTINGHOUSE ELEC CORP PITTSBURGH PA)	200998
OXIDATION AND EQUILIBRIUM IN-NONSTOICHIOMETRIC ZIRCONIUM	200998
DIOXIDE POWDER	200998
J ELECTROCHEM SOC 108, 312 (1961)	200998
CA 55, 13011 (1961)	200998
ARONSON, S	201318
(WESTINGHOUSE ELECT CORP PITTSBURGH PA)	201318
A CALCULATION OF THE HEAT OF SOLUTION OF INTERSTITIAL OXYGEN	201318
IN UO ₂	201318
US AT ENERGY COMM WAPD-BT-23,31 (1961)	201318
CA 56, 5461 (1962)	201318
ARONSON, S BELLE, J	601077
NONSTOICHIOMETRY IN URANIUM DIOXIDE	601077
J CHEM PHYS 29, 151 (1958)	601077
CA 52, 17934 (1958)	601077
ARONSON, S CLAYTON, J	300258
THERMODYNAMIC PROPERTIES OF NONSTOICHIOMETRIC URANIA-ZIRCONIA	300258
SOLID SOLUTIONS	300258
J CHEM PHYS 35, 1055 (1961)	300258
CT 20, 73 (1961)	300258
CA 56, 5464 (1962)	300258
ARONSON, S ROOF, R BELLE, J	601068
(WESTINGHOUSE FLEC CORP PITTSBURGH PA)	601068
KINETIC STUDY OF THE OXIDATION OF URANIUM DIOXIDE	601068
J CHEM PHYS 27, 137 (1957)	601068
CA 51, 17365 (1957)	601068
ARONSSON, B	700585
BORIDES AND SILICIDES OF THE TRANSITION METALS	700585
ARKIV FOR KEMI 16, 379 (1961)	700585
BT 10, 489 (1961)	700585
CA 56, 8276 (1962)	700585
ARONSSON, B	201380
(UNIV UPPSALA UPPSALA SWEDEN)	201380
THE COMPOSITIONS AND CRYSTAL STRUCTURES OF MNB ₂ , MN ₃ Si,	201380
MN ₅ Si ₃ , AND FeSi ₂	201380
ACTA CHEM SCAND 14, 1414 (1960)	201380
CA 56, 8105 (1962)	201380
ARONSSON, B ASELIUS, J STENBERG, E	601166
BORIDES AND SILICIDES OF THE PLATINUM METALS	601166
NATURE 183, 1318 (1959)	601166
CA 54, 21920 (1960)	601166
ARONSSON, B BAECKMAN, M RUNDQVIST, S	201482
(UNIV UPPSALA UPPSALA SWEDEN)	201482
CRYSTAL STRUCTURE OF RE ₃ B	201482
US DEPT COM OFFICE TECH SERV PB REPT 145,859 (1960)	201482
CA 56, 12396 (1962)	201482
ARONSSON, B BAECKMAN, M RUNDQVIST, S	201382
(UNIV UPPSALA UPPSALA SWEDEN)	201382
THE CRYSTAL STRUCTURE OF RE ₃ B	201382
ACTA CHEM SCAND 14, 1001 (1960)	201382
CA 56, 8106 (1962)	201382

ARONSSON, B ENGSTRÖM, I	201348
(UNIV OF UPPSALA UPPSALA SWEDEN)	201348
X-RAY INVESTIGATION ON M-SI-B SYSTEM (M EQUALS MN, FE, CO).	201348
II. SOME FEATURES OF THE FE-SI-B AND MN-SI-B SYSTEMS	201348
ACTA CHEM SCAND 14, 1403 (1960)	201348
CA 56, 6733 (1962)	201348
ARONSSON, B STENBERG, E ASELIUS, J	201388
(UNIV UPPSALA UPPSALA SWEDEN)	201388
BORIDES OF RHENIUM AND THE PLATINUM METALS. THE CRYSTAL	201388
STRUCTURES OF RE7B3, REB, RH7B3, RHB 1.1, IRB 1.1, AND PTB	201388
US DEPT COMM OFFICE TECH SERV PB REPT 145,866, (1959)	201388
CA 56, 8275 (1962)	201388
ARONSSON, B STENBERG, E ASELIUS, J	201349
(UNIV OF UPPSALA UPPSALA SWEDEN)	201349
BORIDES OF RHENIUM AND THE PLATINUM METALS. THE CRYSTAL	201349
STRUCTURE OF RE7B3, REB3, RH7B3, RHB 1.1, IRB 1.1, AND PTB	201349
ACTA CHEM SCAND 14, 733 (1960)	201349
CA 56, 6733 (1962)	201349
ARONSSON, B RUNDQVIST, S	300504
BORIDES, SILICIDES, AND PHOSPHIDES OF THE PLATINUM METALS	300504
PLATINUM METALS REV 5, NO 3, 93 (1961)	300504
BHT NO 3, 28 (1961)	300504
ARONSSON, B STENBERG, E ASELIUS, J	300757
BORIDES OF RUTHENIUM, OSMIUM, AND IRIDIUM	300757
NATURE 195, 377 (1962)	300757
CT NO 16, 102 (1962)	300757
ARMSTRONG, G KRIEGER, L	201512
(NATL BUR STANDARDS WASHINGTON DC)	201512
HEATS OF FORMATION OF INORGANIC COMPOUNDS. A SURVEY	201512
PROGR INTERN RES THERMODYN TRANSPORT PROPERTIES 1962, 8	201512
CA 56, 13628 (1962)	201512
ARROE, H	600959
(U OF WISCONSIN MADISON WISCONSIN)	600959
ISOTOPE SHIFT IN THE CE II SPECTRUM	600959
PHYS REV 93, 94 (1954)	600959
CA 48, 6245 (1954)	600959
ARTYM, R	300773
(ELECTROCHEMICAL INST MOSCOW RUSSIA)	300773
CALCULATION OF THE THERMODYNAMIC FUNCTIONS OF	300773
MULTIATOMIC MOLECULES	300773
ZHUR FIZ KHIM 36, NO 6, 1129 (1962)	300773
ARZHANYI, P	200822
PHASE COMPOSITION OF THE DIFFUSION LAYER	200822
(OF RE IN MO)	200822
ISSLEDVANIYA PO ZHAROPROCH SPLAVAM, AKAD	200822
NAUK SSSR, INST MET IM H H BAIKOVA 5, 119 (1959)	200822
CA 55, 2406 (1961)	200822
ARZHANYI, P VOLKOVA, R PROKOSHIN, D	201975
OXIDATION KINETICS AND STRUCTURE OF CERTAIN OXIDES OF	201975
REFRACTORY METALS	201975
ISSLED PO ZHAROPROCH SPLAVAM AKAD NAUK SSSR	201975
INST MET 9, 172 (1962)	201975
CA 58, 1208 (1963)	201975

ARZHANYI, P VØLKØVA, R PRØKØSHKIN, D	201401
ØXIDATION KINETICS ØF NIØBIUM AND ITS CØMPØUNDS	201401
ISSLEDØVANIYA PØ ZHARØPRØCH SPLAVAM, AKAD NAUK SSSR	201401
INST MET IM AA BAIKØVA 7, 214 (1961)	201401
CA 56, 8428 (1962)	201401
ASARØ, F PERLMAN, I	400572
FIRST EXCITED STATES ØF EVEN-EVEN NUCLIDES IN THE HEAVY	400572
ELEMENT REGION	400572
PHYS REV 87, 393 (1952)	400572
CA 46, 9443 (1952)	400572
ASBRINK, S FRIBERG, S MAGNELI, A ANDERSSØN, G	200825
CRYSTAL STRUCTURE ØF TRIVANADIUM PENTØXIDE	200825
ACAT CHEM SCAND 13, 603 (1959)	200825
CA 55, 3149 (1961)	200825
ASBRINK, S MAGNELI, A	700522
CRYSTAL STRUCTURE STUDIES ØN TRITITANIUM PENTØXIDE, TI3Ø5	700522
ACTA CRYST 12, 575 (1959)	700522
CF 44, 102 (1961)	700522
ASHBEF, K EELFS, W	201994
EPITAXIAL GRØWTH ØF RUTILE ØN ØXIDATION ØF TITANIUM CARBIDE	201994
ACTA CRYST 15, 1312 (1962)	201994
CA 59, 7031 (1963)	201994
ASLANIAN, J CAILLAT, R	201193
(UNIV GRENOBLE GRENOBLE FRANCE)	201193
LØW-TEMP SPECIFIC HEATS ØF IRRADIATED BEØ	201193
CØNTAINING HE	201193
CØMPT REND 253, 1032 (1961)	201193
CA 56, 74 (1962)	201193
ASTØIN, N GRANIER, J	600569
ABSORPTION SPECTRUM ØF NITRØGEN IN THE EXTREME ULTRAVIOLET	600569
CØMPT REND 244, 1350 (1957)	600569
CA 51, 11063 (1957)	600569
ASTRAKHANTSEV, S	900225
MICRØPØRØSITY ØF BERYLLIUM ØXIDE PØWDER	900225
NAUCHNYYE DØKLADY VYSSHEY SHKØLY, METALLURGIYA NØ 5, 226 (1958)	900225
ATHERTON, N BØVEY, L	601327
THE ØPTICAL SPECTRA ØF SOME RARE EARTH	601327
AND ACTINIDE ELEMENTS IN THE 1-2.5	601327
MICRØN REGION PART IV THE SPECTRUM ØF URANIUM	601327
AERE-R-3226, (1960)	601327
NSA 14, 24649 (1960)	601327
ATØDA, T HIGASHI, I TAKAHASHI, Y SASA, Y KØBAYASHI, M	301399
(INST PHYS CHEM RES TØKYØ JAPAN)	301399
URANIUM CARBIDES-X RAY ANALYSIS	301399
SCI PAPERS INST PHYS CHEM RES 55, 217 (1961)	301399
CA 58 4147 (1963)	301399
ATØJI, M	701070
(ANL LEMØNT ILL)	701070
NEUTRØN DIFFRACTION STUDIES ØF HIGHER CARBIDES ØF HEAVY METALS	701070
TID-14175	701070
NSA 17, 3488 (1963)	701070

ATØJI, M			201983
(ARGØNNE NATL LAB	ARGØNNE	ILL)	201983
NEUTRØN DIFFRACTION STUDIES ØF HIGHER CARBIDES ØF HEAVY METALS			201983
J PHYS SØC JAPAN 17, SUPPL B-11, 395 (1962)			201983
CA 58, 1978 (1963)			201983
ATØJI, M			700810
(ARGØNNE NATL LAB	LEMØNT	ILL)	700810
NEUTRØN DIFFRACTION STUDIES ØF CAC2, YC2 ETC			700810
J CHEM PHYS 35, 1950 (1961)			700810
NSA 16, 10563 (1962)			700810
CA 56, 11020 (1962)			700810
ATØJI, M GSCHNEIDNER, K DAANE, A RUNDLE, R SPEDDING, F			700868
THE STRUCTURES ØF LANTHANUM DICARBIDE AND SESQUICARBIDE BY			700868
X-RAY AND NEUTRØN DIFFRACTION			700868
J AM CHEM SØC 80, 1804 (1958)			700868
CA 52, 13355 (1958)			700868
ATØJI, M MEDRUD, R			700867
STRUCTURES ØF CALCIUM DICARBIDE AND URANIUM DICARBIDE BY			700867
NEUTRØN DIFFRACTION			700867
J CHEM PHYS 31, 332 (1959)			700867
CA 54, 1968 (1960)			700867
ATØJI, M WILLIAMS, D			700861
NEUTRØN DIFFRACTION STUDIES ØF LA2C3 ET AL			700861
J CHEM PHYS 35, 1960 (1961)			700861
CA 56, 11016 (1962)			700861
AUBERT, H			201995
(UNIV PARIS	PARIS	FRANCE)	201995
BETA TØ ALPHA TRANSFORMATION IN URANIUM AND ITS ALLØYS			201995
CØMM ENERGIE AT (FRANCE) RAPPT NØ 2186, (1962)			201995
CA 58, 8729 (1963)			201995
AUKRUST, E FØERLAND, T HAGERMARK, K			601605
EQUILIBRIUM MEASUREMENTS AND INTERPRETATION ØF			601605
NØNSTØICHIØMETRY IN UØ2+X			601605
IAEA SYMPOSIUM ØN THE THERMØDYNAMICS ØF			601605
NUCLEAR MATERIALS, PRØC, VIENNA (1962)			601605
NSA 16, 25373 (1962)			601605
AUST, R DRICKAMER, H			301176
(UNIV ØF ILLINØIS	URBANA	ILLINØIS)	301176
CARBØN A NEW CRYSTALLINE PHASE			301176
SCIFNCE 140, 817 (1963)			301176
CA 59, 2239 (1963)			301176
AUSTERMAN, S			201996
(N AM AVIATION INC	CANØGA PARK	CALIF)	201996
RØLE ØF SI, AL, AND ØTHER IMPURTIES IN BE-Ø CRYSTAL			201996
GROWTH			201996
U S AT ENERGY CØMM NAA-SR-8235, 19 (1963)			201996
CA 59, 8195 (1963)			201996
AUSTERMAN, S			301400
(N AM AVIATION	CANØGA PARK	CALIF)	301400
GROWTH ØF BERYLLIA SINGLE CRYSTALS			301400
J AM CERAM SØC 46, 6 (1963)			301400
CA 58, 10797 (1963)			301400
AUSTERMAN, S			701072

ATOMICS INTERNATIONAL . CANOGA PARK CAL)	701072
SUB-CRYSTAL FORMATION IN BE ₂ CRYSTALS AT HIGH TEMPERATURE	701072
J NUCL MATER 6, 332 (1962)	701072
NSA 17, 3518 (1963)	701072
AUSTERMAN, S	201320
DECRYPITATION OF BERYLLIUM OXIDE AT HIGH-TEMPERATURE	201320
US AT ENERGY COMM NAA-SR-6428 (1961)	201320
CA 56, 5463 (1962)	201320
AUSTERMAN, S BELINCOURT, D KRUEGER, H	301127
POLAR PROPERTIES OF BE ₂ SINGLE CRYSTALS	301127
J APPL PHYS 34, 339 (1963)	301127
BHT NO 1, 12 (1963)	301127
AUSTIN, A	601120
(BATTELLE MEM INST COLUMBUS OHIO)	601120
CARBON POSITIONS IN URANIUM CARBIDES	601120
ACTA CRYST 12, 159 (1959)	601120
CA 53, 7711 (1959)	601120
AUSTIN, A GERDS, A	601117
(BATTELLE MEM INST COLUMBUS OHIO)	601117
THE URANIUM-NITROGEN-CARBON SYSTEM	601117
US ATOMIC ENERGY COMM BMI 1272, 18 (1958)	601117
CA 53, 1908 (1959)	601117
AUSTIN, I	201387
(PENN STATE UNIV UNIVERSITY PARK PA)	201387
REDUCING W OXIDE	201387
IND ENG CHEM 53, 659 (1961)	201387
CA 56, 8273 (1962)	201387
AVARDE, R AVGUSTINIK, A VILK, Y KONDRASHOV, Y	300850
NIKOLSKI, S OMELCHENKO, Y ORDANYAN, S	300850
COMPOSITION DIAGRAM OF THE SYSTEM HF-HFC	300850
ZH PRIKL KHIM 35, 1976 (1962)	300850
CA 58, 1954 (1963)	300850
AVER-WELSBACH, H NOWOTNY, H	201175
(UNIV VIENNA VIENNA AUSTRIA)	201175
THE QUESTION OF SCC	201175
MONATSH CHEM 92, 189 (1961)	201175
CA 55, 23145 (1961)	201175
AVGUSTINIK, A	301401
USE OF RARE AND RARE EARTH METALS AND THEIR COMPOUNDS IN	301401
SILICATE TECHNOLOGY	301401
ZH VSES KHIM ODSH MEND 8(2), 135 (1963)	301401
CA 59, 3615 (1963)	301401
BABB, S	301177
PARAMETERS IN THE SIMON EQUATION RELATING PRESSURE AND	301177
MELTING TEMPERATURE	301177
REV MOD PHYSICS 35, 400 (1963)	301177
BABELIOWSKY, T	300858
MASS SPECTROMETRIC DETERMINATION OF THE HEAT OF VAPORIZATION	300858
OF SOME SOLID ELEMENTS	300858
PHYSICA 28, 1160 (1962)	300858
BABELIOWSKY, T	301403

(LAB MASSASCHIEDING AMSTERDAM)	301403
MEASUREMENT OF CHEMICAL EQUILIBRIUM WITH THE MASS	301403
SPECTROMETER AND THE INFLUENCE OF RESIDUAL GASES	301403
PHYSICA 28, 1150 (1962)	301403
CA 58, 971 (1963)	301403
BABELIOWSKY, T	301178
(LAB MASSASCHIEDING AMSTERDAM HOLLAND)	301178
HEAT OF SUBLIMATION OF CAO	301178
J CHEM PHYS 38, 2035 (1963)	301178
CA 59, 4598C (1963)	301178
BABELIOWSKY, T	301180
(FOM LAB VOOR MASSASCHIEDING AMSTERDAM HOLLAND)	301180
INFLUENCE OF RESIDUAL GASES ON THE MEASUREMENT OF CHEMICAL	301180
EQUILIBRIA AT HIGH TEMPERATURES WITH THE KNUDSEN METHOD	301180
J CHEM PHYS 38, 2036 (1963)	301180
BHT NO 2, P2, (1963)	301180
BABELIOWSKY, T BØERBØM, A	301179
(FOM LAB MASSASCHIEDING AMSTERDAM HOLLAND)	301179
MASS-SPECTROMETRIC STUDY OF CAO AND TA	301179
ADVANCED MASS SPECTROMETRY PROC CONF 2ND OXFORD 1961 2,135 (1963)	301179
CA 59, 2229A (1963)	301179
BABELIOWSKY, T BØERBØM, A KRISTEMAKER, J	301128
(LAB MASSASCHIEDING AMSTERDAM)	301128
MASS SPECTROMETRIC DETERMINATION OF THE HEAT OF VAPORIZATION	301128
OF CAO	301128
PHYSICA 28, 1155 (1962)	301128
BHT NO 7, 8 (1963)	301128
BABITZKE, H ASAI, G KATO, H	201988
(US BUR OF MINES ALBANY OREG)	201988
NIOBium-HAFNIUM BINARY ALLOYS FOR ELEVATED TEMPERATURE SERVICE	201988
U S BUR OF MINES REPT INVEST NO 6101, 17 (1962)	201988
CA 58, 2229 (1963)	201988
BACHMANN, H	200795
THE CRYSTAL STRUCTURE OF VANADIUM PENTOXIDE	200795
FORTSCHR MINERAL 38, 194 (1960)	200795
CA 55, 1133 (1961)	200795
BACHMANN, H	201154
(NATL RESEARCH COUNCIL OTTAWA CANADA)	201154
THE CRYSTAL STRUCTURE OF VANADIUM PENTOXIDE	201154
Z KRIST 115, 110 (1961)	201154
CA 55, 21742 (1961)	201154
BADAEVA, T KUZNETSOVA, R	201833
FORMATION OF THE ALLOYS THBE13-UBE13	201833
TR INST MET IM A A BAIKOVA (STRONIE SPLAVOV NEKOTORYKH	201833
SISTEM S URANOM I TORIEM) 1961, 423 (1961)	201833
CA 57, 10884 (1962)	201833
BADAEVA, T	201890
PHASE DIAGRAMS OF THORIUM ALLOYS	201890
TR INST MET IM A A BAIKOVA (STRONIE SPLAVOV NEKOTORYKH	201890
SISTEM S URANOM I TORIEM) 1961, 339 (1961)	201890
CA 57, 13502 (1962)	201890
BADAEVA, T KUZNETSOVA, R	201891
PHASE DIAGRAM OF THE THORIUM-BERYLLIUM SYSTEM	201891

TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM S URANØM I TØRIEM) 1961, 358 (1961) CA 57, 13502 (1962)	201891 201891 201891
BADAEVA, T ALEKSEENKØ, G PHASE DIAGRAM ØF THE THØRIUM-ZIRCØNIUM SYSTEM TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM S URANØM I TØRIEM) 1961, 369 (1961) CA 57, 13502 (1962)	201892 201892 201892 201892 201892
BADAEVA, T ALEKSEENKØ, G STRUCTURE ØF ALLØYS ØF THE THØRIUM-ZIRCØNIUM-URANIUM SYSTEM TRI INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM S URANØM I TØRIEM) 1961, 395 (1961) CA 57, 13503 (1962)	201893 201893 201893 201893 201893
BADAEVA, T KUZNETSØVA, R STRUCTURE ØF ALLØYS ØF THE THØRIUM-CERIUM SYSTEM TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM S URANØM I TØRIEM) 1961, 381 (1961) CA 57, 13504 (1962)	201897 201897 201897 201897 201897
BADAEVA, T KUZNETSØVA, R PHASE DIAGRAM ØF THE URANIUM-MØLYBDENUM-CHROMIUM SYSTEM TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM S URANØM I TØRIEM) 1961, 325 (1961) CA 57, 13504 (1962)	201899 201899 201899 201899 201899
BADER, R (UNIV ØF ØTTAWA ØTTAWA CANADA) THE ELECTRONIC SPECTRA ØF MØCL5 AND NBCL5 CAN J CHEM 39, 2306 (1961) CA 56, 2089 (1962)	201260 201260 201260 201260 201260
BADIALI, M KIRSHENBAUM, N BAKISH, R (ALLØYD ELECTRONICS CØRP CAMBRIDGE MASS) PREPARATION ØF ULTRAPURE MØLYBDENUM CA 58, 7670 (1963)	301404 301404 301404 301404
BADYLKES, I CRITERIONAL EQUATION FØR CALCULATING LATENT HEATS ØF PHASE TRANSITIONS AND VAPØR PRESSURE KHØLØDIL NAYA TEKH 38, 32 (1961)	700593 700593 700593 700593
BAENZIGER, N EICK, H SCHULDT, H EYRING, L (UNIVERSITY ØF IØWA IØWA CITY IØWA) TERBIUM ØXIDES III X-RAY DIFFRACTION STUDIES ØF SEVERAL STABLE PHASES JACS 83, 2219 (1961) CA 55, 21742 (1961)	300184 300184 300184 300184 300184 300184
BAER, P MIESCHER, E NEW BAND SYSTEM ØF THE NØ MOLECULE HELV PHYS ACTA 24, 331 (1951) CA 46, 2396 (1952)	600728 600728 600728 600728
BAER, P MIESCHER, E BAND SPECTRA IN THE SCHUMANN REGION ØF NØ AND N2+ WITH ENRICHED N15 NATURE 169, 581 (1952) CA 46, 6932 (1952)	600729 600729 600729 600729 600729
BAER, P MIESCHER, E	600730

N0, N0+, AND N2+ EMISSION SPECTRA IN THE SCHUMANN REGION HELV PHYS ACTA 26, 91 (1953) CA 47, 9145 (1953)	600730 600730 600730
BAERNIGHAUSEN, H BRAUER, G (UNIV FREIBURG BREISGAU GERMANY) A NEW EUROPIUM OXIDE EU3O4 AND THE ISOTOPE COMPOUND EU2SR04 ACTA CRYST 15, 1059 (1962) NSA 17, 1428 (1963)	701088 701088 701088 701088 701088
BAEV, A NOVIKOV, G THERMODYNAMIC INVESTIGATIONS OF BINARY SYSTEMS OF CERTAIN CHLORIDES OF ALKALI AND RARE EARTH ELEMENTS ZHUR NEORG KHIM 6, 2610 (1961) CA 56, 9503 (1962)	201410 201410 201410 201410 201410
BAGLEY, K OLIVER, D THE SYSTEM URANIUM-OXYGEN-CRITICAL REVIEW OF THE LITERATURE UK AT ENERGY AUTHORITY IND GROUP HDG R+DB(C) TN-41,17 (1959) CA 53, 16672 (1959)	601141 601141 601141 601141
BAIBUZ, V CALCULATION OF EQUILIBRIUM GAS COMPOSITIONS FOR HIGH TEMPERATURES ZHUR FIZ KHIM 36, 1401 (1962)	300601 300601 300601 300601
BAIBUZ, V MEDVEDEV, V INFLUENCE OF PRESSURE ON THERMODYNAMIC FUNCTIONS OF REAL (NONIDEAL) GASES TRUDY INST GORYUCH ISKOPAEM AKAD NAUK SSSR 12, 190 (1961) CA 56, 5459 (1962)	300644 300644 300644 300644 300644
BAILEY, D SMITH, J (IOWA STATE UNIV AMES IOWA) A NOTE ON THE STRUCTURE OF ZR2C0 ACTA CRYST 14, 1084 (1961) CA 56, 15012 (1962)	201546 201546 201546 201546 201546
BAKAKIN, V BELOV, N CRYSTALLOCHEMISTRY OF BERYLLIUM GEOKHIMIYA 1962, 420 CA 57, 5390 (1962)	201714 201714 201714 201714
BAKER, C KELLY, A ENERGY TO FORM AND TO MOVE VACANT LATTICE SITES IN GRAPHITE NATURE 193, NO 4812, 235 (1962) BHT NO 2, 14 (1962)	300524 300524 300524 300524 300524
BAKER, E BUTLER, J (IMPERIAL COL SCI TECH LONDON ENGLAND) A PHASE DIAGRAM FOR THE CALCIUM OXIDE-CARBON DIOXIDE SYSTEM IN THE EUTECTIC REGION NATURE 195, 173 (1962) CA 57, 9272 (1962)	201794 201794 201794 201794 201794 201794
BAKER, T (AT ENERGY AUTHORITY HARWELL ENGLAND) INTERATOMIC DISTANCES IN THE INTERMETALLIC COMPOUNDS MGBE13 AND CABE13 ACTA CRYST 15, 175 (1962) CA 56, 13640 (1962)	201513 201513 201513 201513 201513 201513

BAKER, T BALDØCK, P	300541
HIGH TEMPERATURE PHASE TRANSFORMATION IN BERYLLIA	300541
NATURE 193, NØ 4821, 1172 (1962)	300541
BHT NØ 2, 39 (1962)	300541
BAKER, W	201057
(UNIV ØF TEXAS AUSTIN TEXAS)	201057
LØWER ØXIDATION STATES ØF ZIRCØNIUM	201057
UNIV MICROFILMS (ANN ARBOR MICH) LC CARD NØ MIC 60-6646	201057
DISSERTATION ABSTR 21, 2465 (1961)	201057
CA 55, 16239 (1961)	201057
BAKULINA, I IØNØV, N	601135
(PHYS-TECH INST ACAD SCI LENINGRAD USSR)	601135
DETERMINATION ØF THE IØNIZATION PØTENTIAL ØF URANIUM ATØMS	601135
BY THE METHOD ØF SURFACE IØNIZATION	601135
ZHUR EKSPITL I TEØRET FIZ 36, 1001 (1959)	601135
CA 53, 14714 (1959)	601135
BALE, E	601083
STRUCTURE ØF RHØDIUM	601083
PLATINUM METALS REV 2, 61 (1958)	601083
CA 52, 14473 (1958)	601083
BAUGHAN, E	300866
THE REPULSION ENERGIES IN IØNIC CØMPØUNDS	300866
II. LATTICE ENERGIES ØF SØME METALLIC NITRIDES	300866
TRANS FAR SØC 55, PT 12 2025 (1959)	300866
CA 54, 16166 (1960)	300866
BANISTER, J LEGVØLD, S SPEDDING, F	600674
STRUCTURE ØF THE RARE EARTH METALS AT LØW TEMP	600674
US AT ENERGY CØMM ISC-342 (1953)	600674
CA 50, 3032 (1956)	600674
NSA 7, 5321 (1953)	600674
BANISTER, J LEGVØLD, S SPEDDING, F	600953
STRUCTURE ØF GADØLINIUM, DYSPRØSIUM AND ERBIUM AT LØW	600953
TEMPERATURES	600953
PHYS REV 94, 1140 (1954)	600953
BARANØVSKY, V	300366
MICROMETHOD ØF MEASURING THE HEAT ØF EVAPØRATION	300366
UKRAINSKII CHEMICAL JØURNAL 28, NØ 3 326 (1962)	300366
BARBER, M LINNETT, J TAYLØR, N	300702
(UNIV ØXFØRD ØXFØRD ENGLAND)	300702
HALIDES ØF THE TRANSITION ELEMENTS ØF THE FIRST LØNG PERIØD	300702
J CHEM SØC 1961, 3323 (1961)	300702
CA 56, 5460 (1962)	300702
BARBER, S MARTIN, B	600650
A HEAT CAPACITY FUNCTION WITH VELOCITY DISPERSION FØR	600650
ISØTROPIC SØLIDS	600650
PHYS AND CHEM SØLIDS 9, 198 (1959)	600650
CA 55, 9025 (1961)	600650
BARD, R BØWERSØX, D	601060
(UNIV CAL BERKELEY CALIF)	601060
THE PREPARATION ØF URANIUM DIØXIDE CRYSTALS	601060
US ATØMIC ENERGY CØMM LA-2076 (1957)	601060
CA 51, 12725 (1957)	601060

BARE, D. CARLSON, Ø	201145
(IOWA STATE UNIV	201145
AMES	201145
IOWA)	201145
PHASE EQUILIBRIUMS AND PROPERTIES OF YTTRIUM-TITANIUM	201145
ALLOYS	201145
TRANS AM SOC METALS 53, 1 (1961)	201145
CA 55, 20853 (1961)	201145
BARINSKII, R NADZHAKOV,	200910
ESTIMATION OF CHARGE AND TYPE OF CHEMICAL BOND OF OSMIUM	200910
IN COMPOUNDS BY LIII ABSORPTION SPECTRA	200910
COMPT REND ACAD BULGARE SCI 13, 31 (1960)	200910
CA 55, 7030 (1961)	200910
BARNER, J Ø	301181
(UNIV OF CALIFORNIA	301181
BERKELEY	301181
CALIF)	301181
DESIGN OF A DIFFERENTIAL CALORIMETER SUITABLE FOR MEASUREMENT	301181
OF HIGH-TEMPERATURE HEATS OF SOLID-STATE REACTIONS	301181
BOAS, AUSTRALIAN J SCI 16, 122 (1954)	301181
CA 59, 4595A (1963)	301181
BARNES, E MUNRO, W THACKRAY, R WILLIAMS, J MURRAY, P	601035
(ATOMIC ENERGY RES ESTAB	601035
HARWELL	601035
ENGLAND)	601035
CERAMICS-PREPARATION FABRICATION AND PROPERTIES OF URANIUM	601035
CARBIDE AND URANIUM-URANIUM CARBIDE CERMETS	601035
CA 51, 3303 (1957)	601035
BARON, J	601433
HIGH VACUUM HIGH TEMPERATURE X-RAY CAMERA	601433
CEA-2076 (1961)	601433
NSA 16, 14904 (1962)	601433
BARON, V IVANOVA, K SAVITSKII, E	200918
THE PHASE DIAGRAM OF THE NIOBIUM-MOLYBDENUM-VANA-	200918
DIUM, SYSTEM AND CERTAIN PROPERTIES OF ITS ALLOYS	200918
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK, MET I	200918
TOPЛИVØ 1960, NO 4, 143 (1960)	200918
CA 55, 7247 (1961)	200918
BARRIAULT, R DREIKORN, R FEBER, R GRIFFEL, M HANST, P	300865
LEIGH, C PANISH, M SCHICK, H WARD, C	300865
THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS	300865
FIRST QUARTERLY PROGRESS REPORT SEPT 15, 1962	300865
AVCO RAD-SR-62-186 (1962), 151 p. AD 287412	300865
BARRØW, R	600777
TRIPLET BANDS OF CARBON MONOXIDE	600777
NATURE 189, 480 (1961)	600777
CA 55, 13045 (1961)	600777
BARRØW, R GRATZER, W MALHERBE, J	600704
INTENSITIES OF BANDS IN THE SYSTEM OF CARBON MONOXIDE	600704
PROC PHYS SOC (LONDON) 69, 574 (1956)	600704
BARRØW, R MIESCHER, E	600733
FINE STRUCTURE ANALYSIS OF NITRIC OXIDE ABSORPTION BANDS	600733
IN THE SCHUMANN REGION	600733
PROC PHYS SOC (LONDON) 70A, 219 (1957)	600733
CA 51, 17440 (1957)	600733
BARRØW, R ROWLINSON, H	600896
THE ABSORPTION SPECTRA OF THE GASEOUS MONOXIDES OF	600896
SILICON, GERMANIUM AND TIN IN THE SCHUMAN REGION	600896
PROC ROY SOC 224, 374 (1954)	600896

CA 49, 54 (1955)	600896
BARSON, F	601499
(AMES LAB AMES IOWA)	601499
THERMAL EXPANSION OF RARE EARTH METALS	601499
ISC-831 (1956)	601499
NSA 12, 8348 (1958)	601499
BARSON, F	601318
(IOWA STATE COLL AMES IOWA)	601318
THERMAL EXPANSION OF RARE EARTH METALS	601318
PHYS REV 105, 418 (1957)	601318
NSA 11, 4750 (1957)	601318
BARSON, F LEGVOLD, S SPEDDING, F	601006
(IOWA STATE COLL AMES IOWA)	601006
A LOW-TEMPERATURE DILATOMETRIC STUDY OF SOME RARE EARTH METALS	601006
US AT ENERGY COMM ISC-424, 64 (1953)	601006
CA 50, 5387 (1956)	601006
BARSON, F LEGVOLD, S SPEDDING, F	601052
(IOWA STATE COLLEGE AMES IOWA)	601052
THERMAL-EXPANSION OF RARE EARTH METALS	601052
PHYS REV 105, 418 (1957)	601052
CA 51, 8603 (1957)	601052
BARSON, F LEGVOLD, S SPEDDING, F	700902
THERMAL EXPANSION OF RARE EARTH METALS	700902
ISC-831 USAEC (1956)	700902
CA 52, 14311 (1958)	700902
BARTA, C PETRU, F HAJEK, B	700725
PREPARATION OF SINGLE CRYSTALS OF SCANDIUM OXIDE	700725
NATURWISSENSCHAFTEN 45, 36 (1958)	700725
CA 52, 9702 (1958)	700725
BARTA, J BRIGGS, G WHITE, J	201561
(UNIV SHEFFIELD SHEFFIELD ENGLAND)	201561
PHASE DIAGRAMS OF URANIUM MONOCARBIDE-TRANSITION METAL SYSTEMS	201561
J NUCL MATERIALS 4, 322 (1961)	201561
CA 57, 121 (1962)	201561
BARTH, C KAPLAN, J	600541
THE ULTRAVIOLET SPECTRUM OF THE OXYGEN AFTERGLOW AND THE NIGHT AIRGLOW	600541
J MOL SPECTROSCOPY 3, 583 (1959)	600541
BARTLETT, E	201997
THERMAL PROTECTION OF ROCKET-MOTOR STRUCTURE	201997
AEROSPACE ENG 22, 86 (1963)	201997
CA 58, 8747 (1963)	201997
BARTLETT, E SCHMIDT, F	701052
(BATTELLE MEM INST COLUMBUS OHIO)	701052
REVIEW OF RECENT DEVELOPMENTS IN TECHNOLOGY OF COLUMBIUM AND TANTALUM	701052
DMIC-115 (1961)	701052
NSA 15, 25215 (1961)	701052
BARTLETT, N LÖHMANN, D	201810
(UNIV BRIT COLUMBIA VANCOUVER CANADA)	201810
TWO NEW FLUORIDES OF PLATINUM	201810

PROC CHEM SOC 1960, 14 (1960)	201810
CA 57, 9452 (1962)	201810
BARTLETT, R W WADSWORTH, M E CUTLER, I B	301183
(UNIV OF UTAH	301183
OXIDATION KINETICS OF ZIRCONIUM CARBIDE	301183
TRANS AIME 227, 467 (1963)	301183
BHT NO 2 (1963)	301183
BARTON, J PURDY, G TAGGART, R PARR, J	300210
STRUCTURE AND PROPERTIES OF TITANIUM-RICH TITANIUM-NICKEL	300210
ALLOYS	300210
TRANS AIME 218, 844 (1960)	300210
BATTLES, J ST PIERRE, G SPEISER, R	300310
(OHIO STATE RES FOUND COLUMBUS OHIO)	300310
RESEARCH ON THE OXIDATION BEHAVIOR OF TUNGSTEN	300310
PROG REPT 11, REPT 831-11 (1961)	300310
AD 252602 DIV 17,4	300310
CON AF 33(616) 5721	300310
BASCHE, M SHETKY, L	201132
(ALLIANT CORP CAMBRIDGE MASS)	201132
TECHNIQUES FOR THE PRODUCTION OF ULTRA-PURE BERYLLIUM	201132
US DEPT COMM OFFICE TECH SERV PB REPT 161877 (1960)	201132
CA 55, 19668 (1961)	201132
BASKIN, M TRETYAKOV, V CHAPOROVA, I	201951
DIFFUSION OF TUNGSTEN IN TUNGSTEN, TANTALUM, AND TITANIUM	201951
MONOCARBIDES AND IN THE TIC-WC AND TIC-WC-TAC SOLID SOLUTIONS	201951
FIZ METAL I METALLOVED 14, 422 (1962)	201951
CA 57, 16274 (1962)	201951
BASKIN, M TRETYAKOV, V CHAPOROVA, I	300856
DIFFUSION OF NB IN TIC AND IN THE EQUI-MOLAR TIC-NBC	300856
SOLID SOLUTION	300856
FIZ METAL I METALLOVED 12, (6) 860 (1961)	300856
BATES, L BARNARD, R	201202
(UNIV NOTTINGHAM NOTTINGHAM ENGLAND)	201202
THE ELECTRICAL AND MAGNETIC PROPERTIES OF THE URANIUM	201202
NIOBIUM SYSTEM	201202
PROC PHYS SOC (LONDON) 78, 361 (1961)	201202
CA 56, 100 (1962)	201202
BATSANOVA, L GRIGOREVA, G	201752
THE OPTICAL PROPERTIES OF FLUORIDES OF THE RARE EARTH METALS	201752
OF THE CERIUM GROUP	201752
IZV SIBIRSK OTD AKAU NAUK SSSR 1962, NO 2, 115 (1962)	201752
CA 57, 6739 (1962)	201752
BATTLES, J EBIHARA, W	300853
(OHIO STATE UNIV COLUMBUS OHIO)	300853
RESEARCH ON THE OXIDATION BEHAVIOR OF TUNGSTEN	300853
AD 278295	300853
BAUER, J FIALA, J HRICHOVA, R	201998
NATURAL ALPHA SILICON CARBIDE	201998
AM MINERALOGIST 48, 620 (1963)	201998
BAUGHAN, E	700809
THE HEATS OF VAPORIZATION OF THE ELEMENTS	700809
TRANS FARADAY SOC 50, 322 (1954)	700809

BAUGHAN, E	700876
REPULSION ENERGIES IN IONIC COMPOUNDS - II LATTICE ENERGIES	700876
OF SOME METALLIC NITRIDES	700876
TRANS FARADAY SOC 55, 2025 (1959)	700876
CA 54, 16166 (1960)	700876
BAUMRUCKER, J CHISWIK, H	60165
METALLURGY DIVISION QUARTERLY REPORT OCT-DEC, 1953	60165
USAEC REPORT ANL-5234	60165
BAUN, W	201999
(WRIGHT-PATTERSON A F B DAYTON OHIO)	201999
TRANSFORMATION AT HIGH TEMPERATURES OF HAFNIA AND ZIRCONIA	201999
SCIENCE 140, 1330 (1963)	201999
CA 59, 7226 (1963)	201999
BAUN, W HODGSON, N DESJARDINS, M	202000
(WRIGHT AIR FORCE BASE DAYTON OHIO)	202000
MASS SPECTROGRAPHIC STUDY OF MOLECULAR CARBON IONS FORMED	202000
IN A SPARK SOURCE	202000
J CHEM PHYS 38, 2787 (1963)	202000
CA 59, 8239 (1963)	202000
BAUR, W	300181
UBER DIE VERFEINERUNG DER KRISTALLSTRUKTURBESTIMMUNG	300181
EINIGER VERTRETER DES RUTILTYPUS TiO_2 , SnO_2 , GeO_2 UND MgF_2	300181
ACTA CRYST 9, 515 (1956)	300181
BAUR, W	200955
(UNIV GÖTTINGEN GERMANY)	200955
REFINEMENT OF THE CRYSTAL-STRUCTURE DETERMINATION OF SOME COM-	200955
POUNDS OF THE RUTILE TYPE. III. LATTICE THEORY OF THE RUTILE	200955
TYPE	200955
ACTA CRYST 14, 209 (1961)	200955
CA 55, 11019 (1961)	200955
BAUR, W	700554
ATOMIC DISTANCES AND BONDING ANGLE IN BROOKITE, TiO_2	700554
ACTA CRYST 14, 214 (1961)	700554
BAZAROV, I	300389
THERMODYNAMICS	300389
MOSCOW GOS IZD FIZ MAT LIT 292 (1961)	300389
BAZAROV, I P	301185
THERMODYNAMICS	301185
VOP FILS 16 NO 12 175-176 62	301185
RUSS ACC VOL 15, NO 12, MARCH 1963	301185
BEAUDRY, B DAANE, A	300573
SC-TI SYSTEM AND THE ALLOTROPY OF SC	300573
TRANS AIME 224, 770 (1962)	300573
BEAUMONT, R CHIHARA, H MORRISON, J	200959
(NATL RESEARCH COUNCIL OTTAWA CANADA)	200959
ANOMALY IN THE HEAT CAPACITY OF CHROMIUM AT 38.5 DEGREES	200959
PHIL MAG (8) 5, 188 (1960)	200959
CA 55, 11055 (1961)	200959
BEAVER, W O'Rourke, R HURD, J	700933
(BRUSH BERYLLIUM CO CLEVELAND OHIO)	700933
EFFECT OF PURITY AND MANUFACTURING VARIABLES ON ELEVATED	700933

TEMPERATURE PROPERTIES OF BERYLLIUM	700933
ASTM-272 (1960)	700933
NSA 15, 704 (1961)	700933
BEAVIS, L	701016
(SANDIA CORP ALBUQUERQUE N MEX)	701016
VAPOR PRESSURES OF RARE EARTHS	701016
SCTM-256A-60(14) (1960)	701016
NSA 15, 10931 (1961)	701016
CA 55, 7953 (1961)	701016
BECART, M	202001
THE CHANGE IN AL-O BONDLENGTH FOR THE TRANSITION A-X2EE	202001
CALCULATED USING APPROXIMATE OVERLAP INTEGRALS	202001
COMPT REND ACAD SCI 254, NO 5 831 (1962)	202001
PA 65, 8122 (1962)	202001
BECHER, H	201128
(TECH HOCHSCHULE STUTTGART GERMANY)	201128
BERYLLIUM BORIDE BEB12 WITH TETRAGONAL BORON STRUCTURE	201128
Z ANORG U ALLGEM CHEM 306, 266 (1960)	201128
CA 55, 19570 (1961)	201128
BECHER, H	201932
(TECH HOCHSCHULE STUTTGART GERMANY)	201932
PREPARATION AND STRUCTURE OF AN ALUMINUM-BERYLLIUM BORIDE	201932
Z ANORG ALLGEM CHEM 317, 346 (1962)	201932
CA 57, 15924 (1962)	201932
BECHER, H	300343
ON THE MODIFICATION OF BORON	300343
Z FUER ANORGAN UND ALLGEM CHEM CCCVI, 261 (1960)	300343
COTS 46, 105 (1961)	300343
BECHER, H SCHAEFER, A	301405
(TECH HOCHSCHULE STUTTGART GERMANY)	301405
PREPARATION AND STRUCTURE OF BERYLLIUM BORIDE, BE4B	301405
Z ANORG ALLGEM CHEM 318, 304 (1962)	301405
CA 58, 4142 (1963)	301405
BECHER, H SCHAFER, A	400617
ON THE MODIFICATIONS OF BORON. EXPERIMENTS ON THE	400617
INCORPORATION OF BERYLLIUM IN THE BORON LATTICE	400617
Z FUER ANORGAN UND ALLGEM CHEM 306, 260 (1960)	400617
BECK, P	201948
(UNIV ILL URBANA ILL)	201948
ALLOYS OF TRANSITION ELEMENTS	201948
U S DEPT COM OFFICE TECH SERV PB REPT 171,113 (1960)	201948
CA 57, 16272 (1963)	201948
BECK, W	300977
ELECTRODE POTENTIAL AND CORROSION BEHAVIOR OF SOME BORIDES	300977
OF MOLYBDENUM AND ZIRCONIUM	300977
PLAN PUL 9, 96 (1961)	300977
BHT NO 3, 5 (1961)	300977
BECKER, J BECKER, E BRANDES, R	201091
(BELL TELEPHONE LABS INC MURRAY HILL NEW JERSEY)	201091
REACTIONS OF OXYGEN WITH PURE TUNGSTEN AND TUNGSTEN CONTAIN-	201091
ING CARBON	201091
J APPL PHYS 32, 411 (1961)	201091
CA 55, 17421 (1961)	201091

BECKMAN, G KIESSLING, R	601049
(UNIV UPPSALA UPPSALA SWEDEN)	601049
THERMAL EXPANSION COEFFICIENTS FOR URANIUM BORIDE AND	601049
BETA-URANIUM SILICIDE	601049
NATURE 178, 1341 (1956)	601049
CA 51, 7097 (1957)	601049
BEDARD, F GALLAGHER, J JOHNSON, C	600705
MICROWAVE MEASUREMENT OF D ₀ FOR C ₀	600705
PHYS REV 92, 1440 (1953)	600705
CA 48, 4978 (1954)	600705
BEDREAG, C	601013
ISOTOPE EFFECT IN THE URANIUM SPECTRUM	601013
STUDII CERETARI STIINT 5, 87 (1954)	601013
CA 50, 11813 (1956)	601013
BEDREAG, C	601014
THE ENERGY LEVEL OF THE ELEMENTS 90-100	601014
STUDII CERETARI STIINT 5, 87 (1954)	601014
CA 50, 11813 (1956)	601014
BEECRÖFT, R SWENSON, C	600669
(AMES LAB AMES IOWA)	600669
ON THE EXISTENCE OF A CRITICAL POINT FOR THE PHASE	600669
TRANSITION IN CERIUM	600669
PHYS AND CHEM SOLIDS 15, 734 (1960)	600669
NS 15, 5406 (1961)	600669
BELBECH, B PIEKARSKI, C PERIO, P	601425
(CENTRE ETUDES NUC SACLAY FRANCE)	601425
STRUCTURE OF U ₄₀₉	601425
BULL SOC FRANC MINERALET CRYST 83, 206 (1960)	601425
NSA 15, 13385 (1961)	601425
BELETSKII, M GALPERIN, E	200827
(ALL-UNION SCI-RES INST LENINGRAD RUSSIA)	200827
CRYSTAL STRUCTURE OF SOME PHASES OF ALLOYS OF MG WITH CE AND ND	200827
FIZ METAL I METALLOVED, AKAD NAUK, SSSR 11, 689 (1961)	200827
CA 55, 19706 (1961)	200827
BELIKOV, A	201066
X-RAY DETERMINATION OF THE COEFFICIENT OF THERMAL EXPANSION	201066
SBORNIK NAUCH-TEKH TRUDOV, NAUCH-ISSLEDOVATEL INST MET	201066
CHELYABINSK SOVNARKHOZA 1960, NO 1, 139 (1960)	201066
CA 55, 16323 (1961)	201066
BELIKOV, A SAVINSKAYA, A	300863
CARBIDES OF VANADIUM AND NIOBIUM IN STEEL	300863
IZV A N SSSR OTN MET I TOP NO 6, 67 (1962)	300863
BELL, W TAGAMI, M MERTEN, V	201476
(GEN.DYNAMICS CORP SAN DIEGO CAL)	201476
THE RHODIUM-CHLORINE SYSTEM AT HIGH TEMPERATURE	201476
J PHYS CHEM 66, 490 (1962)	201476
CA 56, 12372 (1962)	201476
BELLAMY, B BAKER, T LIVEY, D	201930
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	201930
THE LATTICE PARAMETER AND DENSITY OF BERYLLIUM OXIDE	201930
DETERMINED BY PRECISE X-RAY METHODS	201930
J NUCL MATER 6, 1 (1962)	201930

CA 57, 15921 (1962)	201930
BELLE, J	601202
PROPERTIES OF URANIUM DIOXIDE	601202
PROC UN INTER CONF PEACEFUL USES AT ENERGY 2ND GENEVA	601202
6, 569 (1958)	601202
CA 54, 4182 (1960)	601202
NSA 15, 26602 (1961)	601202
BELLE, V	601511
(WESTINGHOUSE ELECT CORP PITTSBURGH PA)	601511
RESUME OF UO2 DATA	601511
WAPD-PWR-PMM-429 (1957)	601511
NSA 12, 1920 (1958)	601511
BELLØT, J DØSIER, P HENRY, J	201627
URANIUM-MØLYBDENUM ALLØYS	201627
METAUX 33, 343 (1958)	201627
CA 57, 3145 (1962)	201627
BELØV, N	600676
THE CRYSTAL STRUCTURE OF BADDELEYITE (MØNØCLINIC ZRØ2)	600676
SØVIET PHYS CRYST 5, 436 (1960)	600676
NS 15, 6436 (1961)	600676
BELYAEV, S	700550
PROBLEM OF CALCULATING THE MØMENTS OF INERTIA OF NUCLEI	700550
ZHUR EKSP TL I TEØRET FIZ 40, 672 (1961)	700550
BELYKH, L NESMEYANØV, A	700918
MEASUREMENT OF PRESSURE OF BERYLLIUM ØXIDE VAPØR IN EQUILIBRIUM	700918
WITH SØLID ØXIDE	700918
DØKLADY AKAD NAUK SSSR 128, 979 (1959)	700918
NSA 15, 4012 (1961)	700918
BELYKH, A NESMEYANØV, A	301045
DETERMINATION OF THE VAPØR PRESSURE OF ØXIDES OF LITHIUM,	301045
BØRØN, SILICØN, AND LEAD	301045
FIZ-KHIM ØSNØVY PRØIZV STALI AKAD NAUK SSSR INST MET	301045
FIFTH KØNF 1959, 342 (1961)	301045
CA 58, 5052 (1963)	301045
BENDER, D	601404
ØN THE ELECTRIC PRØP OF THØRIUM	601404
Z METALLKUNDE 40, 257 (1949)	601404
NSA 4, 3974 (1950)	601404
BENESØVSKY, F RUDY, E	900203
STUDIES OF THE URANIUM-THØRIUM-CARBØN SYSTEM	900203
MØNATSHEFT FUER CHEMIE 92, 1176 (1961)	900203
AEC-TR-5175	900203
BENESØVSKY, F RUDY, E	100181
INFØRMATION ØN THE SYSTEMS URANIUM-ZIRCONIUM (HAFNIUM,	100181
NIØBIUM, TANTALUM) CARBØN	100181
PLANSEEBERICHTE FUER PULVER METALLURGIE 9, 65 (1961)	100181
CØTS 48, 272 (1961)	100181
BENESØVSKY, F RUDY, E	300542
INVESTIGATIONS ØN THE SYSTEM U-TH-C	300542
MØNATSH CHEM 92, 1176 (1961)	300542
BHT NØ 2, 39 (1962)	300542

BENFSØVSKY, F RUDY, E	700974
CONTRIBUTION ON THE STRUCTURE OF ZIRCONIUM-CARBON AND	700974
HAFNIUM-CARBON SYSTEMS	700974
PLANSEEBER PULVERMET 8, 66 (1960)	700974
CA 55, 1381 (1961)	700974
NSA 15, 684 (1961)	700974
 BENØIT, R	 700820
PARAMAGNETIC STUDY OF BINARY COMPOUNDS	700820
J CHIM PHYS 52, 119 (1955)	700820
CA 49, 10688 (1955)	700820
 BENSON, S	 300365
CHEMICAL KINETICS AND THERMODYNAMIC CONSISTENCY	300365
J CHEM EDUC 39, 321 (1962)	300365
 BENESØVSKY, F RUDY, E	 301406
INVESTIGATION OF THE SYSTEMS U-ZR (HF, NB, TA)	301406
AERE, HARWELL, TR NØ 1483	301406
(CONS TRAN SUM SEPT 1961 P 219)	301406
 BENTLE, G	 301130
(ATOMICS INTERN CANØGA PARK CAL)	301130
SOME ELASTIC PROPERTIES OF BEØ AT ROOM TEMPERATURE	301130
J NUCL MATER 6, (3) 336 (1962)	301130
BHT NØ 1, 13 (1963)	301130
 BENZ, R WAGNER, C	 700640
THERMODYNAMICS OF THE SOLID SYSTEM CAØ-SIØ2 FROM ELECTROMOTIVE	700640
FORCE DATA	700640
J PHYS CHEM 65, 1308 (1961)	700640
 BEREZHNØI, A	 201469
ADVANCES IN BINARY SYSTEMS OF SILICON	201469
ZHUR VSESØYUZ KHIM ØBSHCHESTVA IM DI MENDELEEVA 6, 618 (1961)	201469
CA 56, 11245 (1962)	201469
 BEREZHNØI, A	 201541
THERMODYNAMIC PROPERTIES OF ZIRCONIUM OXIDES, ZIRCONIUM,	201541
ALUMINUM AND MAGNESIUM TITANATES	201541
DØPØVIDI AKAD NAUK UKR RSR 1962, NØ 1, 65	201541
CA 56, 15000 (1962)	201541
 BEREZHNØI, A KØRDYUK, R	 201553
THE SYSTEM LIME-MAGNESIA-ZIRCONIA-SILICA AND ITS SIGNIFICANCE	201553
IN THE TECHNOLOGY OF REFRACTØRIES	201553
ØGNEUPØRY 27, NØ 2, 85 (1962)	201553
CA 56, 15169 (1962)	201553
 BEREZHNØIS, A GULKØ, N	 202002
SUB-SOLIDUS STRUCTURE OF THE SYSTEM CAØ-MGØ-AL2Ø3-TIØ2-SIØ2	202002
SØR NAUCH TRUD UNIIØ NØ 5 65, (1961)	202002
RUSS.ACC 1615, 3298 (1963)	202002
 BERG, J	 300390
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF SOME RARE EARTHS	300390
DISS ABST 22, 2599 (1962)	300390
CCP NØ 5, 369 (1962)	300390
 BERG, J	 201562
(IØWA STATE UNIV AMES IØWA)	201562
HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF SOME OF THE RARE	201562
EARTH ELEMENTS	201562

UNIV MICROFILMS (ANN ARBOR MICH) ORDER NO 61-6177, CA 57, 141 (1962)	201562 201562
BERG, J (IOWA STATE UNIV AMES IOWA) HEAT CAPACITY OF LANTHANUM DOCTORAL THESIS	700760 700760 700760 700760
BERG, K (LAB ATOMENERGI STOCKHOLM SWEDEN) THERMAL CONDUCTIVITY OF UO2 A/CNF 15/P/141 NSA 13, 7044 (1959)	601544 601544 601544 601544 601544
BERG, K FLINTA, J SELTRØP, L (LAB ATOMENERGI STOCKHOLM SWEDEN) THERMAL CONDUCTIVITY OF UO2 PROC U N INTERN CNF PEACEFUL USES AT ENERGY 2ND GENEVA 1958 7, 691 CA 56, 14952 (1962)	201533 201533 201533 201533 201533 201533
BERG, R SINANØGLU, Ø LIGAND-FIELD THEORY OF LINEAR GASEOUS MOLECULES INVOLVING THE FIRST TRANSITION SERIES ELEMENTS J CHEM PHYS 32, 1082 (1960) NSA 14, 13726 (1960)	300177 300177 300177 300177 300177
BERGER, I I SEVASTYANOV, N G, PUTILINA, L K THE OXIDES OF TUNGSTEN ZHURNAL NEORGANICHESKOI KHIMII VOL 1- NO 8, 1956 COTS, APRIL, (1963)	301186 301186 301186 301186
BERGMAN, G MEDVEDEV, V INVESTIGATION OF THE THERMODYNAMIC PROPERTIES OF SILICON OXIDE VAPORS AND THEIR CONDENSATION BY A METHOD INVOLVING EXPLOSION IN A SPHERICAL BOMB SBORNIK TRUDOV GOSUDARST. INST. PRIKLAD. KHIM 1959, NO 42, 158 CA 55, 26632 (1961)	300674 300674 300674 300674 300674 300674
BERGVALL, P HAGSTRØM, S (UNIV OF UPPSALA UPPSALA SWEDEN) ATOMIC LEVEL ENERGIES IN RARE EARTH ELEMENTS ARKIV FYSIK 17, 61 (1960) NSA 14, 16100 (1960)	601341 601341 601341 601341 601341
BERINGER, R RAWSON, E HENRY, A MICROWAVE RESONANCE IN NITRIC OXIDE LAMBDA DOUBLING AND HYPERFINE STRUCTURE PHYS REV 94, 343 (1954) CA 48, 7436 (1954)	600734 600734 600734 600734 600734
BERKOWITZ, J HEAT FORMATION OF THE CN RADICAL J CHEM PHYS 36, 2533 MAY 15 (1962)	301407 301407 301407
BERKOWITZ, J (ARGONNE NATL LAB LEMONT ILL) CORRELATION SCHEME FOR DIATOMIC OXIDES J CHEM PHYS 30 858 (1959) DATA ON BI0, BO, MG0, SI0,	301187 301187 301187 301187 301187
BERLINCOURT, T HALL EFFECT, RESISTIVITY AND MAGNETORESISTIVITY OF TH, U, ZR,	601655 601655

TI AND NR	601655
PHYS REV 114, 969 (1959)	601655
BERMAN, A ZEMANSKY, M BØRSE, H	700886
NORMAL AND SUPERCONDUCTING HEAT CAPACITIES OF LANTHANUM	700886
PHYS REV 109, 70 (1958)	700886
CA 52, 9691 (1958)	700886
BERNSTEIN, B SMITH, J	700807
A CALCULATION OF THE ELASTIC CONSTANTS OF YTTRIUM AND THE RARE	700807
EARTH METALS	700807
IS 118, (1959)	700807
CA 56, 9848 (1962)	700807
BERTAUT, F BLUM, P	700813
HEXABORIDES AND ALKALINE SUBSTITUTIONS	700813
COMPT REND 234, 2621 (1952)	700813
CA 46, 8926 (1952)	700813
BESSERER, C	700929
(JOHNS HOPKINS UNIV SILVER SPRING MD)	700929
RAMJET TECHNOLOGY-MATERIALS FOR RAMJET ENGINES AND COMPONENTS	700929
TG-370-14 (1958)	700929
NSA 15, 14727 (1961)	700929
BESSONOV, A VLASOV, V	201942
REACTION OF URANIUM WITH NITROGEN	201942
FIZ METAL I METALLOVED 14, 478 (1962)	201942
CA 57, 16264 (1962)	201942
BESSONOV, A VLASOV, V	201954
KINETICS OF URANIUM OXIDATION WITH AIR, OXYGEN, AND CARBON	201954
DIOXIDE	201954
IZV VYSSHIKH UCHEBN ZAVEDENII, TSVETN MLT 5, NO 4, 137 (1962)	201954
CA 58, 52 (1963)	201954
BESSONOV, A VASLOV, V	201390
REACTION OF METALLIC URANIUM WITH CARBON DIOXIDE	201390
FIZ METAL I METALLOVED AKAD NAUK SSSR 12, 775 (1961)	201390
CA 56, 8404 (1962)	201390
BESSONOV, A VASLOV, V	201468
PHASE TRANSFORMATIONS DURING OXIDATION OF METALLIC URANIUM	201468
FIZ METAL I METALLOVED AKAD NAUK SSSR 11, 957 (1961)	201468
CA 56, 11199 (1962)	201468
BESSONOV, A F VLASOV, V G	301188
KINETICS OF URANIUM OXIDATION WITH AIR OXYGEN AND CARBON	301188
DIOXIDE	301188
IZV VYSSHIKH UCHEBN ZAVEDENII TSVETN MET 5 137 (1962)	301188
CA 58, 52C (1963)	301188
BETHE, H	301131
THE PASSAGE OF ELECTRONS THROUGH THE ELECTRIC FIELD OF A	301131
LATTICE	301131
VOL LIV, 703 (1929)	301131
Z FUER PHYSIK	301131
*AEC UCRL TR 917 (L)	301131
COTS 63, 198 (1963)	301131
BETHOUX, O THOMAS, P WEIL, L	201534
(UNIV GRENOBLE FRANCE)	201534
LOW-TEMPERATURE THERMAL CONDUCTIVITY OF UO2	201534

COMPT REND 253, 2043 (1961)	201534
CA 56, 14952 (1962)	201534
BETTERIDGE, W RHYS, D	202003
(MOND NICKEL CO LONDON ENGLAND)	202003
THE HIGH-TEMPERATURE OXIDATION OF THE PLATINUM METALS AND	202003
THEIR ALLOYS	202003
CA 59, 8440 (1963)	202003
BITTNER, H GORETZKI, H	202004
MAGNETIC STUDY OF THE CARBIDES OF TITANIUM, ZIRCONIUM,	202004
HAFNIUM, VANADIUM, NIOMIUM, AND TANTALUM	202004
MONATSH CHEM 93, 1000 (1962)	202004
BHIDE, V DAMLE, R	201596
(INST SCI BOMBAY INDIA)	201596
PHASE TRANSITION AND SPECIFIC HEAT ANOMALY IN MANGANESE	201596
DIOXIDE	201596
J SCI IND RES (INDIA) 20B, 405 (1961)	201596
CA 57, 1641 (1962)	201596
BHIDE, V DANI, R	201324
(INST SCI BOMBAY INDIA)	201324
ELECTRICAL CONDUCTIVITY IN THE OXIDES OF MANGANESE AND RELATED	201324
COMPOUNDS	201324
PHYSICA 27, 821 (1961)	201324
CA 56, 5481 (1962)	201324
BIBB, A BEARD, A DOUGLAS, D	201344
(GEN ELEC CO SCHENECTADY NY)	201344
INVESTIGATION OF BINARY ZIRCONIUM ALLOYS	201344
US AT ENERGY COMM KAPL-2162, (1961)	201344
CA 56, 5743 (1962)	201344
BICKERDIKE, R HUGHES, G	300156
AN EXAMINATION OF PART OF THE TITANIUM-CARBON SYSTEM	300156
JOUR OF THE LESS-COMMON METALS 1, 42 (1959)	300156
BIDELMAN, W	100193
LINE OF THE RARE EARTH ELEMENTS IN THE SPECTRUM OF R	100193
ANDROMEDAE	100193
ASTROPHYSICS J 117, 377 (1953)	100193
CA 47, 7314 (1953)	100193
BIEGANSKI, Z STALINSKI, B	700660
HEAT CAPACITIES AND THERMODYNAMIC FUNCTIONS OF VANADIUM AND	700660
VANADIUM HYDRIDE WITHIN THE RANGE 24 TO 340 DEGREES K	700660
HYDROGEN CONTRIBUTION TO THE HEAT CAPACITY OF TRANSITION METAL	700660
HYDRIDES	700660
BULL ACAD POLON SCI SER SCI CHIM 9, 367 (1961)	700660
CCP NO 8, 679 (1961)	700660
BIGEISEN, J	600799
VAPOR PRESSURES AND RELATED THERMODYNAMIC PROPERTIES OF THE	600799
ISOTOPIC NITRIC OXIDE MOLECULES	600799
J CHEM PHYS 33, 1775 (1960)	600799
CA 55, 16048 (1961)	600799
BILTZ, W	900126
THE TEMPERATURE DEPENDENCY OF THE VALENCE IN METALS AND OXYGEN	900126
NACH GES WISS GÖTTINGEN MATH-PHYSIK KLASSE 1908, 293 (1908)	900126
BINDER, I	700816

NEW BORIDES OF YTTRIUM	700816
POWDER MET BULL 7, 74 (1956)	700816
CA 51, 1804 (1957)	700816
BINDER, I	700830
(UNION CARBIDE TARRYTOWN NY)	700830
STRUCTURE AND PROPERTIES OF RARE EARTH AND YTTRIUM HARD METALS	700830
J AM CERAM SOC 43, 287 (1960)	700830
CA 54, 16776 (1960)	700830
NSA 14, 17018 (1960)	700830
BINDER, I LAPLACA, S POST, B	700818
(FIRTH STERLING INC YONKERS NY)	700818
SOME NEW RARE EARTH BORIDES	700818
PROC CONF BORON SYNTHESIS, STRUCTURE, PROPERTIES ASBURY PARK	700818
NJ (1959)	700818
CA 55, 10186 (1961)	700818
NSA 15, 17834 (1961)	700818
BINDER, I POST, B	200779
MANGANESE DIBORIDE	200779
ACTA CRYST 13, 356 (1960)	200779
CA 55, 51 (1961)	200779
BINDERS, L	601259
(SCHORZKOPF DEVELOPMENT CORP YONKERS NY)	601259
NEW BORIDES OF YTTRIUM	601259
POWDER MET BULL 7, 74 (1956)	601259
NSA 10, 8429 (1956)	601259
BIRCHENALL, C	200775
IONIC DISORDER IN MANGANESE OXIDE	200775
TRANS AIME 218, 1134 (1960)	200775
CA 55, 6978 (1961)	200775
BIRYUKOVA, L SAKSONOV, Y	200851
PRODUCTS OF THE REACTION OF METALLIC TITANIUM WITH	200851
TITANIUM TETRACHLORIDE	200851
ZHUR NEORG KHIM 5, 993 (1960)	200851
CA 55, 4218 (1961)	200851
BITTNER, H GORETZKI, H	301132
MAGNETIC INVESTIGATIONS OF THE CARBIDES TIC, ZRC, HFC, VC,	301132
NBC, AND TAC	301132
GERMAN PER MONATSHEFTE FUER CHEMIE, VOL XCIII, NO 5, 1962,	301132
1000 (1962) *SLA	301132
COTS 63, 113 (1963)	301132
BLACKBURN, P	201961
(WESTINGHOUSE ELEC CORP PITTSBURGH PA)	201961
THE MECHANISM OF THE NIOBIUM REACTION WITH WATER VAPOR AND	201961
WITH OXYGEN	201961
J ELECTROCHEM SOC 109, 1142 (1962)	201961
CA 58, 315 (1963)	201961
BLACKBURN, P	300543
VAPOR PRESSURE OF TUNGSTEN OXIDES	300543
ANGEW CHEM 74, 83 (1962)	300543
BHT NO 2, 40 (1962)	300543
BLACKBURN, P	601113
(WESTINGHOUSE ELEC. CO. PITTSBURGH PA)	601113
OXYGEN DISSOCIATION PRESSURES OVER URANIUM OXIDES	601113

J PHYS CHEM 62, 897 (1958)	601113
CA 53, 40 (1959)	601113
BLACKBURN, P E	301189
THE MECHANISM OF THE NI0BUIM REACTION WITH WATER VAPOR AND	301189
WITH OXYGEN	301189
J ELECTROCHEM SOC 109, 1142 (1962)	301189
NSA 17 NO 2 1441 (1963)	301189
BLACKBURN, P ANDREW, K GULBRANSEN, E BRASSART, F	601582
(WESTINGHOUSE ELECTRIC CORP PITTSBURGH PA	601582
OXIDATION OF TUNGSTEN AND TUNGSTEN BASED ALLOYS	601582
WADC-TR-59-575 (1960)	601582
NSA 16, 5672 (1962)	601582
BLACKBURN, P WEISSBART, J GULBRANSEN, E	601114
(WESTINGHOUSE ELEC. CO. PITTSBURG PA)	601114
OXIDATION OF URANIUM DIOXIDE	601114
J PHYS CHEM 62, 902 (1958)	601114
CA 53, 406 (1959)	601114
BLAIR, L BEACHAM, H NELSON, W	300150
TITANIUM COMPOUNDS	300150
ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY 14, 219 (1953)	300150
BLAISE, J	601123
ISOTOPIC SHIFT IN ATOMIC SPECTRA OF HEAVY ELEMENTS	601123
ANN PHYS 3, 1019 (1958)	601123
CA 53, 8802 (1959)	601123
BLAISE, J VETTER, R	202005
(C N R S BELLEVUE FRANCE)	202005
DETERMINATION OF THE IONIZATION POTENTIAL OF THULIUM	202005
FROM ARC SPECTRA	202005
COMPT REND 256, 630 (1963)	202005
CA 58, 8482 (1963)	202005
BLANC, B	201346
VACUUM THERMODYNAMICS AND KINETICS	201346
VIDE 16, 257 (1961)	201346
CA 56, 6722 (1962)	201346
BLANPAIN, R	300349
SPECIFIC HEAT OF RHENIUM	300349
BULL CLASSE SCI ACAD ROY BELG 57, 750 (1961)	300349
CCP NO. 2, 118 (1962)	300349
CA 56, 11001 (1962)	300349
BLAUER, J A GREENBAUM, M A FARBER, M	301190
THE THERMODYNAMICS OF SEVERAL LIGHT METAL OXIDES HALIDES AND	301190
OXYHALIDES	301190
QUARTERLY REPT 3 NOV 1962 FEB 1963 AD 401 379	301190
TAB 63-3-2, 150 (1963)	301190
BLATT, F	201043
(CLARENDON LAB OXFORD ENGLAND)	201043
METASTABLE GAMMA PHASE URANIUM-MOLYBDENUM ALLOYS	201043
PHYS AND CHEM SOLIDS 17, 177 (1961)	201043
CA 55, 14258 (1961)	201043
BLÖCK, F FERRANTE, M	201013
(US BUR OF MINES ALBANY ORE)	201013
VANADIUM BY METALLIC REDUCTION OF A VANADIUM TRICHLORIDE	201013

J ELECTROCHEM SOC 108, 464 (1961)	201013
CA 55, 13239 (1961)	201013
BLØK, N GLAZOVA, A LASHKØ, N KURAEVA, V MØLCHANØVA, E	201490
PHASE ANALYSIS ØF ALLØYS BASED ØN TITANIUM	201490
ZAVØDSK LAB 27, 1470 (1961)	201490
CA 56, 12621 (1962)	201490
BLØMEKE, J ZIEGLER, W	400562
THE HEAT CØNTENT, SPECIFIC HEAT, AND ENTRØPY ØF LA2Ø3, PR6Ø11	400562
AND ND2Ø3 BETWEEN 30 AND 900 DEGREES	400562
J AM CHEM SOC 73, 5099 (1951)	400562
CA 46, 1857 (1952)	400562
BLITØN, J RECHTER, H HARADA, Y	301133
(ARMØUR RES FØUNDATION CHICAGO ILL)	301133
FLAME SPRAYED ZIRCØNIA FILMS FØR FUEL CELL CØMPØNENTS	301133
AM CERAM SOC BULL 42, (1) 6 (1963)	301133
BHT NØ 1, 33 (1963)	301133
BLØKHIN, M SHUVAEV, A	201778
(STATE UNIV RØSTØV RUSSIA)	201778
EFFECT ØF CHEMICAL BINDING ØN THE EMISSION X-RAY SPECTRUM	201778
ØF TITANIUM	201778
IZV AKAD NAUK SSSR SER FIZ 26, 429 (1962)	201778
CA 57, 8069 (1962)	201778
BLUE, G D GREEN, J W EHLERT, T C MARGRAVE, J L	301191
DISSØCIATION ENERGIES ØF THE ALKALINE EARTH MØNØFLUØRIDES	301191
NATURE 199 804 (1963)	301191
BLUM, A WIELICZKØ, J	300491
A NEW TEST FØR DETERMINING THE RESISTANCE TØ THERMAL SHØCK ØF	300491
TIR2-BASE CØMPØSITIONS	300491
PLANSEEBER PULVERMET 9, 77 (1961)	300491
BHT NØ 3, 18 (1961)	300491
BLUM, P BERTAUT, F	700848
STUDY ØF BØRIDES HAVING HIGH BØRØN CØNTENT	700848
ACTA CRYST 7, 81 (1954)	700848
BLUMENTHAL, B	601044
(ARGØNNE NAT LAB LEMØNT ILLINOIS)	601044
A PRELIMINARY REPØRT ØN THE URANIUM CARBØN SYSTEM	601044
U S ATØMIC ENERGY CØMM TID 7523, 65 (1956)	601044
CA 51, 5524 (1957)	601044
BLUMENTHAL, B	601692
(ARGØNNE NAT LAB LEMØNT ILL)	601692
CØSTITUTION ØF LØW-CARBØN U-C ALLØYS	601692
US AT ENERGY CØMM ANL-5958, 36 (1959)	601692
CA 54, 9697 (1960)	601692
BLUMENTHAL, B	601342
(ARGØNNE NATL LAB LEMØNT ILL)	601342
THE TRANSFØRMATION TEMPERATURES ØF HIGH	601342
PURITY URANIUM	601342
J NUCLEAR MATERIALS 2, 23 (1960)	601342
NSA 14, 14092 (1960)	601342
BLUMENTHAL, R WHITMØRE, D	600829
ELECTROCHEMICAL BEHAVIØR ØF ELEVATED TEMPERATURE	600829
THERMODYNAMIC PRØPERTIES ØF CERTAIN IRØN AND	600829

MANGANESE OXIDE MIXTURES J AM CERAM SOC 44, 508 (1961)	600829 600829
BLUMENTHAL, R WHITMORE, D (NORTHWESTERN UNIV EVANSTON ILL) THERMODYNAMIC STUDY OF PHASE EQUILIBRIA IN THE TI-O SYSTEM WITHIN THE TI01.95-TI02 REGION J ELECTROCHEM SOC 110, 92 (1962) BHT NO 4 (1962)	601666 601666 601666 601666 601666 601666
BODAEVA, T KUZNETSOVA, R CONSTITUTION OF THE ALLOY TH-ZRC STROENIE I SVOSTVA SPLAVOV URANA TORIYA I TSIRKONIYA SB STATE 1963, 223 (1963) CA 59, 8432 (1963)	202006 202006 202006 202006 202006
BODMER, A (ADE FORT HALSTEAD KENT ENGLAND) SPECTROSCOPIC ISOTOPE SHIFT AND NUCLEAR DEFORMATIONS PROC ROY SOC 67, 622 (1954) CA 49, 716 (1955)	600936 600936 600936 600936 600936
BÖESCHÖTEN, F (REACTOR CENTRUM HAGUE NETHERLANDS) HALL EFFECT OF THORIUM PHYSICA 25, 398 (1959) NSA 13, 15529 (1959)	601528 601528 601528 601528 601528
BÖETTCHE, A SCHNEIDER, G PROPERTIES OF URANIUM MONOCARBIDE PROC U N INTERN CONF PEACEFUL USES AT ENERGY 2ND GENEVA 6, 561 (1958) CA 54, 4182 (1960)	601201 601201 601201 601201 601201
BÖGDANOVA, N LÖGINOV, G MAGNETIC SUSCEPTIBILITY OF VANADIUM OXIDE AT 80 DEGREES TO 370 DEGREES K FIZ TVERD TELA 4, NO 1, 236 (1962) SOVIET PHYSICS-SOLID STATE 4, NO 1, 167 (1962)	300640 300640 300640 300640 300640
BÖHMVITENSE, E (NEUE UNIV. KIEL GERMANY) THE SPECTRA OF SOME METALLIC LINE STARS Z ASTRÖPHYS 49, 243 (1960) CA 54, 19152 (1960)	601169 601169 601169 601169 601169
BÖKSHTAIN, S GUBAREVA, M KISHKIN, S MÖRÖZ, L DIFFUSION, RECRYSTALLIZATION, AND PHASE TRANSFORMATIONS CA 58, 1198 (1963)	301408 301408 301408
BÖLEF, D (WESTINGHOUSE RESEARCH LABS PITTSBURGH PA) ELASTIC CONSTANTS OF SINGLE CRYSTALS OF THE BODY-CENTRED CUBIC TRANSITION ELEMENTS V, NB, AND TA J APPL PHYS 32, 100 (1961) CA 55, 10006 (1961)	200936 200936 200936 200936 200936 200936
BÖLES, S (US BUR MINES COLLEGE PARK MD) RARE EARTH COMPOUNDS AS HIGH TEMPERATURE REFRACTORIES A BIBLIOGRAPHY US BUR MINES INFORM CIRC 8082, (1962) CA 57, 12118 (1962)	201859 201859 201859 201859 201859 201859

BØLGAR, A VERKHØGLYADØVA, T SAMSONØV, G	700938
VAPØR PRESSURE AND EVAPØRATION RATE ØF SOME HIGH-MELTING	700938
CØMPØUNDS IN VACUUM AT ELEVATED TEMPERATURES	700938
IZVEST AKAD NAUK SSSR ØTDEL TEKH NAUK MET I TØPLIVØ NØ 1, 142	700938
(1961)	700938
NSA 15, 17344 (1961)	700938
CA 55, 19660 (1961)	700938
BHT NØ 3, 21 (1961)	700938
BØLØTIN, G VØLØSHINKII, A KIRILLØVA, M NØSKØV, M	201830
SØKØLØV, A CHARIKØV, B	201830
ØPTICAL PRØPERTIES ØF TI AND V IN THE INFRARED SPECTRAL REGIØN	201830
FIZ METAL I METALLØVED 13, 823 (1962)	201830
CA 57, 10673 (1962)	201830
BØMBERGER, H	300369
TITANIUM	300369
IND ENG CHEM 54, NØ 1 73 (1962)	300369
CA 56, 3225 (1962)	300369
BØNDAR, I	200937
PHASE DIAGRAMS ØF SYSTEMS CØNTAINING RARE EARTH ØXIDES	200937
KHIM PRAKT PRIMENENIE SILIKATØV, INST KHIM SILIKATØV,	200937
AKAD NAUK SSSR 1960, 5 (1960)	200937
CA 55, 10036 (1961)	200937
BØNDARENKØ, B ERMAKØV, S	202007
THERMIØNIC PRØPERTIES ØF METAL CARBIDES ØF IV AND V GRØUPS	202007
RADIØTEKH I ELEKTRØN 7 NØ 12, 2099 (1962)	202007
RUSS ACC 15, NØ 11, 2861 FEBRUARY (1963)	202007
BØNDARENKØ, B ERMAKØV, S	301409
THERMØELECTRIC PRØPERTIES ØF GRØUPS IV AND V METAL CARBIDES	301409
CA 58, 7460 (1963)	301409
BØNNELLE, C	201754
(LAB CHIM PHYS PARIS FRANCE)	201754
EMISSION SPECTRUM ØF METALLIC CHRØMIUM IN THE L REGIØN	201754
CØMPT REND 254, 2313 (1962)	201754
CA 57, 6750 (1962)	201754
BØØNE, D WERT, C	301410
(UNIVERSITY ØF ILLINØIS URBANA ILLINØIS)	301410
INTERSTITIAL-DISLØCATION INTERACTION IN NIØBIUM	301410
J PHYS SOC (JAPAN) 18, SUPPL 1, 141 (1963)	301410
CA 59, 6088 (1963)	301410
BØØRSE, H BERMAN, A WØRLEY, R ZEMANSKY, M	700887
HEAT CAPACITIES ØF VANADIUM, TANTALUM, AND LANTHANUM IN THE	700887
SUPERCØDUCTING AND NØRMAL PHASES	700887
BULL INST INTERN FRØID ANNEXE 499, 1955	700887
CA 53, 17656 (1959)	700887
BØØRSE, H HIRSHFELD, A LEUPØLD, H	600651
DIFFERENCE IN LATTICE SPECIFIC HEATS IN THE NØRMAL AND SUPER-	600651
CØDUCTING PHASES	600651
PHYS REV LETTERS 5, 246 (1960)	600651
CA 55, 9025 (1961)	600651
BØRCHARDT, H THØMPSON, B	200887
REACTIONS ØF ALKALINE EARTH ØXIDES III A REEXAMINATION ØF THE	200887
HEDVALL EFFECT	200887

J AM CHEM SOC 82, 5630 (1960)	200887
CA 55, 6230 (1961)	200887
BÖRELIUS, G	601168
(RÖY. INST TECH. STÖCKHÖLM SWEDEN)	601168
ORIGIN OF THE INTERNAL PRESSURE IN METALS	601168
ARKIV FYSIK 16, 413 (1960)	601168
CA 54, 19172 (1960)	601168
BØRGEN, Ø SEIP, H	201514
(NØRGES TEKN HØEGSKØLE TRØNDHEIM NØRWAY)	201514
CRYSTAL STRUCTURE OF BETA-Si3N4	201514
ACTA CHEM SCAND 15, 1789 (1961)	201514
CA 56, 13643 (1962)	201514
BØRISENKØ, A	900208
PROTECTION OF NIØBIUM FROM HIGH TEMPERATURE GAS CORROSION	900208
ZASHCHITA NIØBIYA OT VYSØHTEMPERATURNØY GAZØVØY KØRRØZII,	900208
INSTITUT KHIMII SILIKATØV AKAD NAUK SSSR 1 (1961)	900208
FTD-TT-62-1251	900208
BØRISENKØ, L	300447
SCANDIUM	300447
RUSSIAN BØØK (1961)	300447
CØTS NØ 53, 115 (1962)	300447
BØRØS, J	301192
RESEARCH ON VANADIUM PENTOXIDE	301192
EPITØIPAN ES KØZLEK EGYET TUD KØZL 7, NØ 1 45 (1961)	301192
AD 299934	301192
TAB 63, 240 (1963)	301192
BØRØVSKII, I BARINSKII, R	400551
FINE STRUCTURE OF ABSØRBTION SPECTRA	400551
DØKLADY AKAD NAUK SSSR 72, 31 (1950)	400551
CA 45, 2309 (1951)	400551
BØRØVSKII, I MARCHUKØVA, I	201014
A METHOD OF CØNSTRUCTING PHASE-CØMPØSITIØN DIAGRAMS	201014
TRUDY INST MET IM AA BAIKØVA 1960, NØ 6, 73 (1960)	201014
CA 55, 13252 (1961)	201014
BØSCH, F	202008
(UNIV GHENT BELGIUM)	202008
SYNTHESES OF BØRØN CARBIDE AND NITRIDF	202008
SILICATES IND 27, 587 (1962)	202008
CA 58, 8676 (1963)	202008
BØSCH, G	201505
(PHILLIPS RES LABS EINDHØVEN NETH)	201505
THERMAL CØDUCTIVITY OF SILICØN CARBIDE	201505
PHILIPS RES REPTS 16, 455 (1961)	201505
CA 56, 13568 (1962)	201505
BØULLE, A JARY, R DØMINE-BERGES, M	400537
AN X-RAY STUDY OF THE APPEARANCE OF GRAIN IN URANIUM ØXIDES	400537
CØMPT REND 229, 214 (1949)	400537
CA 44, 7698 (1950)	400537
BØVEY, L	700825
(AT ENERGY RESEARCH EST BERKS ENGLAND)	700825
AN EXTENSION OF THE ANALYSIS OF THE YTTRIUM SPECTRUM	700825
PRØC PHYS SOC (LØNDØN) 68A, 79 (1955)	700825

CA 49, 5961 (1955)	700825
NSA 9, 2988 (1955)	700825
BOVEY, L. ATHERTON, N. STEERS, E. (A.E.R.E. HARWELL ENGLAND)	601422
THE OPTICAL SPECTRUM OF URANIUM IN THE 1-2.5MU REGION	601422
SPECTROCHIM ACTA 17, 259 (1961)	601422
NSA 15, 14280 (1961)	601422
BOVEY, L. STEERS, E. ATHERTON, N.	601190
THE OPTICAL SPECTRA OF SOME RARE EARTH AND TRANSURANIC ELEMENTS IN THE 1-3MU REGION II WAVE LENGTH MEASUREMENT AND THE SPECTRUM OF PLUTONIUM	601190
AT ENERGY RESEARCH ESTAB R2977, 13 (1959)	601190
CA 54, 10502 (1960)	601190
BOVEY, L. WISE, H.	601154
THE EMISSION AND ABSORPTION SPECTRA OF URANIUM EXCITED IN A KING FURNACE	601154
AT ENERGY RESEARCH ESTAB C/R2766, 199 (1959)	601154
CA 53, 21139 (1959)	601154
BOWMAN, A.	600836
(LASL LOS ALAMOS NEW MEXICO)	600836
THE VARIATION OF LATTICE PARAMETER WITH CARBON CONTENT OF TANTALUM CARBIDE	600836
J PHYS CHEM 65, 1596 (1961)	600836
NSA 15, 31238 (1961)	600836
PA 65, 2388 (1962)	600836
BOWMAN, F.	601345
NUCLEAR FUEL RESEARCH, FUEL CYCLE DEVELOPMENT PROGRAM-THE CARBIDES OF URANIUM	601345
AN ANNOTATED BIBLIOGRAPHY	601345
NYO 2686, (1960)	601345
NSA 14, 12839 (1960)	601345
BOYD, F. ENGLAND, J.	301193
(CARNEGIE INST WASHINGTON DC)	301193
THE QUARTZ-COESITE TRANSITION	301193
J GEOPHYS RES 65, 749 (1960)	301193
CA 57, 4359 (1962)	301193
BRABERS, M.	601212
ELECTRICAL CONDUCTIVITY OF URANIUM OXIDES	601212
PROC U N INTERN CONF PEACEFUL USES AT ENERGY 2ND	601212
GENEVA 6, 122 (1958)	601212
CA 54, 994 (1960)	601212
BRACKETT, T.	600706
DISSOCIATION ENERGY OF CARBON MONOXIDE	600706
J CHEM PHYS 24, 1103 (1956)	600706
CA 50, 10507 (1956)	600706
BRADLEY, J.	301411
(OHIO STATE UNIV COLUMBUS OHIO)	301411
CRYSTAL GROWTH	301411
NEWS ENG 35 NO 2, 7 (1963)	301411
CA 59, 3373 (1963)	301411
BRADFORD, S.	300368
THE EFFECT OF OXYGEN ON PHYSICAL AND CHEMICAL PROPERTIES OF	300368

VANADIUM DISSERTATION ABST 22, NO 7 2348 (1961-62)	300368 300368
BRADY, P THEORETICAL STUDY OF HIGH-TEMPERATURE COMPOUNDS BOND DISSOCIATION ENERGIES U S DEPT COM OTS P B REPT 161546 (1960) CA 56, 14931 (1962)	301412 301412 301412 301412 301412
BRANSCOMB, L THE INFRARED SPECTRUM OF ACTIVE NITROGEN PHYS REV 82, 83 (1951) CA 45, 5022 (1951)	600570 600570 600570 600570
BRAUER, G INVESTIGATIONS OF THE CESIUM-OXYGEN SYSTEM Z ANORG U CHEM 225, 101 (1947) CA 43, 2884 (1949)	400601 400601 400601 400601
BRAUER, G ESSELBORN, R (UNIV FREIBURG BREISGAU GERMANY) NIOBIUM OXYNITRIDES Z ANORG U ALLGEM CHEM 308, 52 (1961) CA 55, 18408 (1961)	201114 201114 201114 201114 201114
BRAUER, G (UNIV FRIEBURG I BR FRIEBURG GERMANY) NITRIDE PHASES OF NIOBIUM Z ANORG U ALLGEM CHEM 309, 151 (1961) CA 55, 20742 (1961)	201142 201142 201142 201142 201142
BRAUER, G (ALBERT-LUDWIGS UNIV FREIBURG GERMANY) NITRIDES, CARBONITRIDES, AND OXYNITRIDES OF NIOBIUM J LESS COMMON METALS 2, 131 (1960) CA 55, 14236 (1961)	201037 201037 201037 201037 201037
BRAUER, G ESSELBORN, R NITRIDE PHASES IN NIOBIUM Z ANORG U ALLGEM CHEM 309, 151 (1961)	700575 700575 700575
BRAUER, G GINGERICH, K THE CERIUM OXIDE SYSTEM AEC-TR-4368 ANGEW CHEM 69, 480 (1957) NSA 15, 5383 (1961) NS 15, 5383 (1961)	600668 600668 600668 600668 600668 600668
BRAUER, G GINGERICH, K HOLTSCMIDT, U OXIDES OF CERIUM IV OXYGEN DISSOCIATION PRESSURE IN THE SYSTEM OF CERIUM OXIDES J INORG AND NUCLEAR CHEM 16, 77 (1960) CA 55, 5101 (1961)	300415 300415 300415 300415 300415
BRAUER, G GINGERICH, K CERIUM OXIDES V HIGH-TEMPERATURE X-RAY EXAMINATIONS OF CERIUM OXIDES JOUR INORGANIC AND NUC CHEM 16, 87 (1960) COTS 55, 90 (1962) CA 55, 5101 (1961)	300559 300559 300559 300559 300559 300559
BRAUER, G GRADINGER, H HETEROTYPE MIXED PHASES AMONG RARE EARTH OXIDES	600978 600978

Z ANORG U ALLGEM CHEM 276, 209 (1954) CA 49, 2923 (1955)	600978 600978
BRAUER, G LITKE, W MELTING POINT AND THERMAL DISSOCIATION OF TITANIUM DIOXIDE INORG AND NUCLEAR CHEM 16, 67 (1960) CA 55, 5099 (1961)	201990 201990 201990 201990
BRAUER, G MORAWIETZ, H (UNIV FREIBURG BREISGAU GERMANY) ON THE CRYSTAL STRUCTURE OF NbO Z ANORG ALLGEM CHEM 317, 13 (1962) BHT NO 4 (1962)	301106 301106 301106 301106 301106
BRAUER, G MUELLER, H KUHNER, G SUB-OXIDE OF LOW TEMPERATURE OXIDATION OF NIOBIUM AND TANTALUM CHEMISCHES LAB DER UNIVERSITAT FREIBURG IM BREISGAU COTS 55, 102 (1962)	301105 301105 301105 301105 301105
BRAUER, G MORAWIETZ, H STRUCTURE OF NIOBIUM MONOXIDE Z ANORG ALLGEM CHEM 137, 13 (1962)	301414 301414 301414
BRAUER, G MUELLER, H (UNIV FREIBURG BREISGAU GERMANY) UNSTABLE SUBOXIDES AND HYDRIDES OF NIOBIUM AND TANTALUM PLANSEE PROC 3RD SEMINAR RENTLE 1 TYROL 257 (1958)	301197 301197 301197 301197
BRAUER, G MUELLER, H KUEHNER, G (UNIVERSITY FREIBURG BREISGAU GERMANY) OXIDES OF NIOBIUM AND TANTALUM FORMED IN LOW-TEMPERATURE OXIDATION J LESS-COMMON METALS 4, 533 (1962) CA 58, 7692 (1963)	301413 301413 301413 301413 301413 301413
BRAUER, G MUELLER, H OXIDES OF THE LOW TEMPERATURE OXIDATION OF NIOBIUM AND TANTALUM GERMAN RPT 24 AEC-TR-5298 COTS 168, (1963)	301196 301196 301196 301196 301196 301196
BRAUN, H SEDLATSCHKE, K KIEFFER, B ALLOYS OF NIOBIUM WITH MOLYBDENUM AND TUNGSTEN PLANSEEBER PULVERMET 8, 58 (1960) CA 55, 1377 (1961)	200806 200806 200806 200806
BRCIC, B GOLIC, L JERNEJIC, J SIFTAR, J VZLOVSEK, B (UNIV LJUBLJANA YUGOSLAVIA) THE SYSTEM CaO PLUS SiO2 III. THE REASON OF THE INCREASED REACTIVITY OF THE CaO COMPONENTS MONTASH CHEM 93, 550 (1962) CA 57, 4091 (1962)	201636 201636 201636 201636 201636 201636
BREDIG, M THE HIGH TEMPERATURE CUBIC PHASES OF URANIUM AND LANTHANUM DICARBIDES J AM CERAM SOC 43, 493 (1960) CA 54, 23582 (1960)	700852 700852 700852 700852 700852
BREDIG, M (OAK RIDGE NATL LAB OAK RIDGE TENN)	201323 201323

X-RAY STUDIES OF CALCIUM CARBIDE	201323
Z ANORG U ALLGEM CHEM 310, 338 (1961)	201323
CA 56, 5474 (1962)	201323
BRESKER, R VORONIN, N LATYSHEVA, Z	300799
INFRARED RADIATION SOURCES BASED ON SILICON CARBIDE	300799
PRIBORY I TEKH EKSPER (USSR) 1959, NO 4, 149 (1959)	300799
ENG TRANS INSTRUM EXPEN TECH NO 4, 670 (1960)	300799
PA 65, 5172 (1962)	300799
BREWER, L	202009
PREDICTION OF HIGH TEMPERATURE METALLIC PHASE DIAGRAMS	202009
UCRL-10701 JULY (1963)	202009
BREWER, L SOMAYAJULU, G BRACKETT, E	202010
(UNIV OF CALIF BERKELEY CALIF)	202010
THERMODYNAMIC PROPERTIES OF GASEOUS METAL DIHALIDES	202010
CHEM REV 63, 111 (1963)	202010
BREWER, L	700906
(RADIATION LAB U. CALIF BERKELEY CALIF)	700906
THERMODYNAMICS OF RARE EARTH OXIDES	700906
UCRL-1931 (1952)	700906
NSA 7, 108 (1953)	700906
BREWER, L	700921
THE THERMODYNAMIC PROPERTIES OF THE OXIDES AND THEIR	700921
VAPORIZATION PROCESSES	700921
CHEM REV 52, 1 (1953)	700921
BREWER, L BRÖMLEY, L GILLES, P LÖFGREN, N	400581
THERMODYNAMIC PROPERTIES AND EQUILIBRIA AT HIGH TEMPERATURES	400581
OF URANIUM HALIDES, OXIDES, NITRIDES AND CARBIDES	400581
USAEC REPT MDDC 1543, (1947)	400581
CA 46, 2895 (1952)	400581
BREWER, L BRÖMLEY, L GILLES, P LÖFGREN, N	601145
(U. OF CALIFORNIA BERKLEY CALIFORNIA)	601145
THERMODYNAMIC PROPERTIES AND EQUILIBRIUMS OF URANIUM HALIDES	601145
OXIDES, NITRIDES AND CARBIDES AT HIGH TEMPERATURE	601145
US AT ENERGY COMM TID-5290 1, 219 (1958)	601145
CA 53, 16676 (1959)	601145
BREWER, L CHANDRASEKHARIAH, M	700721
FREE ENERGY FUNCTIONS FOR GASEOUS MONOXIDES	700721
UCRL 8713 (1959)	700721
CA 53, 16626 (1959)	700721
BREWER, L ENGELKE, J	300797
SPECTRUM OF C3	300797
J CHEM PHYS 36, NO 4, 992 (1962)	300797
PA 65, 6166 (1962)	300797
BREWER, L HARALDSEN, H	600987
(U OF CALIFORNIA BERKELEY CALIFORNIA)	600987
THE THERMODYNAMIC STABILITY OF REFRACTORY BORIDES	600987
J ELECTROCHEM SOC 102, 399 (1955)	600987
CA 50, 2254 (1956)	600987
BREWER, L HICKS, W KRIKORIAN, O	300813
HEAT OF SUBLIMATION AND DISSOCIATION ENERGY OF GASEOUS C2	300813
J CHEM PHYS 36, 182 (1962)	300813
PA 65, 2028 (1962)	300813

BREWER, L MASTIK, D	601633
THE STABILITY OF GASEOUS MANGANESE OXIDE	601633
UCRL-570 (1949)	601633
BREWER, L MASTIK, D	601634
THE STABILITY OF GASEOUS SnO , ZnO , ClO , CuO ,	601634
PbO , GeO , SiO AND TiO	601634
UCRL-571 (1949)	601634
BREWER, L ROSENBLATT, G	201111
(UNIV OF CALIFORNIA BERKELEY CALIFORNIA)	201111
DISSOCIATION ENERGIES OF GASEOUS METAL DIOXIDES	201111
CHEM REVS 61, 257 (1961)	201111
CA 55, 18278 (1961)	201111
BREWER, L ROSENBLATT, G	300855
THERMODYNAMICS OF SUBOXIDE VAPORIZATION	300855
TRANS MET SOC AIME 224, NO 6, 1268 (1962)	300855
BREWER, L SAWYER, D TEMPLETON, D DAUBEN, C	601400
THE OXIDES OF URANIUM AND THORIUM	601400
AEC-2823 FEB 14, (1950)	601400
NSA 4, 3419 (1950)	601400
BREWER, L TRAJMAR, S	300788
ULTRAVIOLET BANDS OF MAGNESIUM HYDROXIDE AND OXIDE	300788
J CHEM PHYS 36, NO 6, 1585 (1962)	300788
PA 65, 8105 (1962)	300788
BREWER, L SOMAYAJULU, G BRACKETT, E	301415
(UNIV OF CALIFORNIA BERKELEY CAL)	301415
THERMODYNAMICS PROPERTIES OF GASEOUS METAL DIHALIDES	301415
CHEM REV 63, 111 (1963)	301415
CA 58, 12014 (1963)	301415
BREWER, L TRAJMAR, S BERG, R	201780
(UNIV CAL BERKELEY CAL)	201780
ANALYSIS OF THE ULTRAVIOLET SYSTEM OF MAGNESIUM OXIDE	201780
ASTROPHYS J 135, 955 (1962)	201780
CA 57, 8073 (1962)	201780
BRIDGE, J SCHWARTZ, C VAUGHAN, D	601656
X-RAY DIFFRACTION DETERMINATION OF THE COEFFICIENTS OF	601656
EXPANSION OF ALPHA-URANIUM	601656
J MET 8, 1282 (1956)	601656
BRIDGMAN, P	400533
(HARVARD UNIV CAMBRIDGE MASS)	400533
THE ELECTRIC RESISTANCE TO 30000 KG/CM ² OF TWENTY NINE METALS	400533
AND INTERMETALLIC COMPOUNDS	400533
PROC AM ACAD ARTS AND SCI 79, 149 (1951)	400533
CA 45, 9398 (1951)	400533
BRIDGMAN, P	700883
COMPRESSION OF 39 SUBSTANCES TO 100000 KG/CM ²	700883
PROC AM ACAD ARTS SCI 76, 55 (1948)	700883
CA 42, 6194 (1948)	700883
BRIDGMAN, P	700884
ROUGH COMPRESSIONS OF 177 SUBSTANCES TO 40000 KG/CM ²	700884
PROC AM ACAD ARTS SCI 76, 71 (1948)	700884
CA 42, 8043 (1948)	700884

BRIGGS, G GUHA, J BARTA, J WHITE, J	301416
(UNIV SHEFFIELD SHEFFIELD ENGLAND)	301416
SYSTEMS OF UC, UC2 AND UN WITH TRANSITION METALS	301416
BRIT CERAM SOC 62, NO 3, 221 (1963)	301416
CA 59, 3624 (1963)	301416
BRIGHT, N	601288
(CANADA DEPT OF MINES CANADA)	601288
THE DETERMINATION OF THE U-O ATOMIC RATIO IN NON-STOICHIOMETRIC	601288
URANIUM DIOXIDE AND OTHER OXIDES OF URANIUM	601288
JUL 5, 1956 MD-207	601288
NSA 11, 105 (1957)	601288
BRIGHT, N	300661
(DEPT MINES TECH SURVEY OTTAWA CANADA)	300661
X-RAY STUDIES IN THE TI-O SYSTEM	300661
ADVAN. X-RAY ANAL 4, 175 (1961)	300661
CA 57, 1650 (1962)	300661
BRILLIANTOV, N STAROSTINA, L FEDOROV, O	300807
PREPARING MONOCRYSTALS OF MOLYBDENUM AND TUNGSTEN	300807
BY CRUCIBLESS ZONE MELTING	300807
KRISTALLOGRAFIYA 6, 261 (1961)	300807
PA 65, 2364 (1962)	300807
BRISI, C ABBATTISTA, F	201507
(POLYTECHN TURIN ITALY)	201507
SOLID STATE EQUILIBRIUMS IN THE SYSTEMS U-BE-C AND TH-BE-C	201567
ANN CHIM (ROME) 51, 1404 (1961)	201507
CA 56, 13604 (1962)	201507
BRIX, P	400527
ISOTOPE DISPLACEMENT AND TERM SCHEME OF THE SAMARIUM ATOM, SMI	400527
Z PHYSIK 126, 431 (1949)	400527
CA 44, 1329 (1950)	400527
BRIX, P	400566
ISOTOPE DISPLACEMENT EFFECT IN THE ATOMIC SPECTRA OF THE RARE	400566
EARTHS (ISOTOPE DISPLACEMENTS CONSTANTS OF EUROPIUM,	400566
GADOLINIUM, AND YTTERBIUM)	400566
Z PHYSIK 132, 579 (1952)	400566
CA 46, 10878 (1952)	400566
BRIX, P ENGLER, H	100192
ISOTOPIC DISPLACEMENT IN THE GDI SPECTRUM	100192
Z PHYSIK 133, 362 (1952)	100192
CA 47, 7315 (1953)	100192
BRIX, P ENGLER, H	400563
ISOTOPE SHIFT IN THE GD I SPECTRUM	400563
NATURWISSENSCHAFTEN 38,214 (1951)	400563
CA 46, 1865 (1952)	400563
BRIX, P FRANK, H	400526
ISOTOPE DISPLACEMENT IN THE SPECTRUM OF CE	400526
Z PHYSIK 127, 289 (1950)	400526
CA 44, 5703 (1950)	400526
BRIX, P HERZBERG, G	600544
THE DISSOCIATION ENERGY OF OXYGEN	600544
J CHEM PHYS 21, 2240 (1953)	600544
CA 48, 4270 (1954)	600544

BRIX, P HERZBERG, G	600548
FINE STRUCTURE OF THE SCHUMANN-RUNGE BANDS NEAR THE	600548
CONVERGENCE LIMIT AND THE DISSOCIATION ENERGY OF THE	600548
OXYGEN MOLECULE	600548
CAN J PHYSICS 32, 110 (1954)	600548
CA 48, 6250 (1954)	600548
BRIX, P KÖPFERMAN, H	400543
ISOTOPE DISPLACEMENTS IN THE SPECTRUM OF SAMARIUM	400543
Z PHYSIK 126, 344 (1949)	400543
CA 44, 454 (1950)	400543
BRIX, P KÖPFERMAN, H	400574
MAGIC NUMBERS AND THE ISOTOPE SHIFT IN ATOMIC SPECTRA OF HEAVY	400574
ELEMENTS	400574
PHYS REV 85, 1050 (1952)	400574
CA 46, 5979 (1952)	400574
BRØIDA, H GAYDØN, A	600547
THE HERZBERG BANDS OF OXYGEN IN AN OXYGEN AFTERGLOW AND IN	600547
THE NIGHT SKY SPECTRUM	600547
PROC ROY SOC LONDON 222, 181 (1954)	600547
CA 48, 6250 (1954)	600547
BRØNSØN, H CHISHØLM, H DØCKERTY, S	700561
ON THE SPECIFIC HEATS OF TUNGSTEN, MØLYBDENUM AND CØPPER	700561
CAN J RES 8, 282 (1933)	700561
CA 27, 2618 (1933)	700561
BRØØKS, M KAPLAN, J	600571
DISSOCIATION ENERGY OF NO AND N2	600571
PHYS REV 96, 1540 (1954)	600571
CA 49, 3658 (1955)	600571
BRØPHY, J KAMDAR, M WULFF, J	201340
(MIT CAMBRIDGE MASS)	201340
THE TA-W-RE SYSTEM	201340
TRANS AIME 221, 1137 (1961)	201340
CA 56, 5738 (1962)	201340
BRØPHY, J KREIDER, K WULFF, J	202011
NICKEL-ACTIVATED SINTERING OF PLASMA-SPRAYED TUNSTEN	202011
DEPOSITS	202011
TRANS AIME 227, 598 (1963)	202011
BRØPHY, J SCHWARZKØPF, P WULFF, JJ	200803
TANTALUM-RHENIUM SYSTEM	200803
TRANS MET SOC AIME 218, 910 (1960)	200803
CA 55, 324 (1961)	200803
BRØSSET, C MAGNUSSØN, B	200932
(CHALMERS UNIV GØTERBØRG SWEDEN)	200932
THE SILICON-BØRØN SYSTEM	200932
NATURE 187, 54 (1960)	200932
CA 55, 9133 (1961)	200932
BRØUNSHTEIN, B	300187
DETERMINATION OF THE OPTIMUM NUMBER OF TERMS IN THE ASYMPTOTIC	300187
EXPRESSION FOR THE STATISTICAL SUMMATION OVER VIBRATIONAL	300187
ENERGY LEVELS OF DIATOMIC MOLECULES	300187
ZHUR FIZ KHIM 35, 1558 (1961)	300187

BRUNSHTEIN, B YURKOV, G	301417
EVALUATION OF THE ERRORS IN THE CALCULATIONS OF	301417
THERMODYNAMIC FUNCTIONS BY APPROXIMATE METHODS	301417
ZH FIZ KHIM 36, 2303 (1962)	301417
CA 58, 3961 (1963)	301417
BRUNSHTEIN, B YURKOV, G	300364
CRITICAL REMARKS TO THE PAPER BY RI ARTYM ON THE CALCULATION	300364
OF THERMODYNAMIC FUNCTIONS OF IDEAL GASES FROM SPECTROSCOPIC	300364
DATA	300364
ZHUR FIZ KHIM 36, 5 1110 (1962)	300364
BRUNSHTEIN, B YURKOV, G	300774
(LENINGRAD INST APPLIED CHEM LENINGRAD RUSSIA)	300774
APPROXIMATE METHOD FOR THE CALCULATION OF THE THERMODYNAMIC	300774
FUNCTIONS OF DIATOMIC IDEAL GASES AT HIGH TEMPERATURE	300774
WITH ACCOUNT OF THE HIGHER ANHARMONICITY CONSTANTS	300774
ZHUR FIZ KHIM 36, NO 6, 1191 (1962)	300774
BROWN, A	701044
(GT BRIT ROYAL AIRCRAFT EST HAMPSHIRE ENGLAND)	701044
SILICON CARBIDE A REVIEW	701044
RAE-TN-MET-PHYS-325 (1960)	701044
AD-249685	701044
NSA 15, 21155 (1961)	701044
BROWN, D STOB, J	301198
(C A PARSONS + CO N C UPON TYNE ENGLAND)	301198
PROPERTIES OF URANIUM MONOCARBIDE	301198
TRANS BRIT CERAM SOC 62, 2 (1963)	301198
BHT NO 2 12, (1963)	301198
BROWN, W KIRCHNER, H	601430
(CORNELL AERONAUTICAL LAB BUFFALO NEW YORK)	601430
AN INVESTIGATION OF THE THEORETICAL AND PRACTICAL	601430
ASPECTS OF THE THERMAL EXPANSION OF CERAMIC	601430
MATERIALS, QUART PROG REPT (1961)	601430
CAL-PI-1273-M-10	601430
NSA 16, 16715 (1962)	601430
BRUBERS, M	601545
(JOINT EST FOR NUCL EN RES KJELLER NORWAY)	601545
ELECTRICAL CONDUCTIVITY OF U-O SYST	601545
A/CNF 15/P/1474	601545
NSA 13, 6876 (1959)	601545
BRUNO, M	601385
ANOMALOUS SOLID SOLUTIONS OF CERIUM SESQUIOXIDE IN CERIUM	601385
DIOXIDE	601385
RICERA SCI 20, 645 (1950)	601385
NSA 5, 154 (1951)	601385
BRYAN, R HOLT, R OLKENBERG, O	600549
RECOMBINATION AND AFTERGLOW IN NITROGEN AND OXYGEN	600549
PHYS REV 106, 83 (1957)	600549
CA 51, 16090 (1957)	600549
BRYANT, C KEESOM, P	600831
LOW TEMPERATURE SPECIFIC HEAT OF MOLYBDENUM	600831
J CHEM PHYS 35, 1149 (1961)	600831
BRYNESTAD, J	301199
ON THE PHASE RULE	301199

Z PHYSIK CHEMIA 36, 356 (1963)	301199
BRYUKHANOV, A GOLUB, V	400614
MASS-SPECTROMETER	400614
RUSSIAN, PATENT NO 139 478	400614
CA 56, 5801 (1962)	400614
BUCHLER, A	201465
(ARTHUR D LITTLE INC CAMBRIDGE MASS)	201465
INFRARED SPECTRA OF GASEOUS GROUP IV HALIDES	201465
ZIRCONIUM-FLUORINE, ZIRCONIUM CHLORIDE, AND HAFNIUM CHLORIDE	201465
US DEPT COM OFFICE TECH SERV PB REPT 148,429, (1960)	201465
CA 56, 11086 (1962)	201465
BUCHLER, A BERKOWITZ-MATTUCK, J DUGRE, C	300183
INFRARED SPECTRA OF GASEOUS GROUP IV HALIDES ZIRCONIUM,	300183
HAFNIUM, AND THORIUM FLUORIDES AND CHLORIDES	300183
INTERIM TECH REPT NO 4 ON STUDY OF HIGH TEMP THERM OF LIGHT	300183
METAL COMPOUNDS FEB 22, 1961 DA 19-020-ORD-4829	300183
OCR REPT NO 006.4	300183
AD-252 510 DIV 25 (1961)	300183
BUCKLEY, J	301418
(LANGLEY RES CENTER HAMPTON VA)	301418
DETERIORATION OF CALCIA-STABILIZED ZR02	301418
NASA TECH NOTE D-1595 (1962)	301418
CA 58, 7604 (1963)	301418
BUDDERY, J WELCH, J	600940
(IMPERIAL COL. SCI. TECH. LONDON ENGLAND)	600940
BORIDES AND SILICIDES OF THE PLATINUM METALS	600940
NATURE 167, 362 (1951)	600940
CA 45, 5553 (1951)	600940
BUDNIKOV, P BELYAEV, R	701043
BERYLLIUM OXIDE AND ITS PROPERTIES	701043
ZHUR PRIKLAD KHIM 33, 1921 (1960)	701043
CA 55, 2228 (1961)	701043
NSA 15, 4326 (1961)	701043
BUDNIKOV, P BEREZHNOY, A	900219
TECHNOLOGY OF CERAMICS AND REFRACTORIES	900219
FTD-TT-63-104	900219
BUDNIKOV, P CHEREPANOV, A	301419
ZIRCONIUM COMPOUNDS AND THEIR USE	301419
ZH VSES KHIM OBRSHCESTVA IM D I MENDELEEVA 8, NO 2,	301419
141 (1963)	301419
CA 59, 3521 (1963)	301419
BUDNIKOV, P GINSTLING, A	300315
REACTIONS IN MIXTURES OF SOLIDS	300315
MOSCOW GOSUDARST IZDATEL LIT PO STROITEL ARKHITEKT I	300315
STROITEL MATERIALAM 423 (1961)	300315
CA 55, 21779 (1961)	300315
BUDNIKOV, P SHISHKOV, N	300470
CRYSTALLIZATION OF BERYLLIUM OXIDE FROM A GASEOUS PHASE	300470
DOKLADY AKAD NAUK SSSR 138, 1093 (1961)	300470
BHTG NO 4, 12 (1962)	300470
BUDNIKOV, P TRESVYATSKII, S KUSHAKOVSKII, V	201395
PHASE TRANSFORMATIONS OF URANIUM OXIDES IN AIR	201395

DOKLADY AKADEMIY NAUK SSSR 128, 85 (1959) CA 56, 8417 (1962)	201395 201395
BUDWORTH, D HOARE, F PRESTON, J THE THERMAL AND MAGNETIC PROPERTIES OF SOME TRANSITION ELEMENT ALLOYS PROC ROY SOC (LONDON) A257, 250 (1960) CA 55, 323 (1961)	200802 200802 200802 200802 200802
BULEWICZ, F STABILITIES OF THE GASEOUS DIATOMIC HALIDES OF CERTAIN METALS (LI, NA, K, RB, CS, GA, IN, TL, NI, MN, CR) TRANS FARADAY SOC 57, 921 (1961) CA 56, 73 (1962)	201190 201190 201190 201190 201190
BUNDY, F MELTING OF GRAPHITE AT VERY HIGH PRESSURE J CHEM PHYS 38, 618 (1963)	300859 300859 300859
BUNDY, F (G E RES LAB SCHENECTADY NY) MELTING POINT OF GRAPHITE AT HIGH PRESSURE. HEAT OF FUSION SCIENCE 137, 1055 (1962)	300854 300854 300854 300854
BUNDY, F STRONG, H (G E RES LAB SCHENECTADY NY) BEHAVIOR OF METALS AT HIGH TEMPERATURES AND PRESSURES SOLID STATE PHYSICS F SEITZ AND D TURNBULL EDITORS ACADEMIC PRESS CA 57, 5444 (1962)	201719 201719 201719 201719 201719 201719
BURBRIDGE, E BURBRIDGE, G (CAVENDISH LAB CAMBRIDGE ENGLAND) RELATIVE ABUNDANCES AND ATMOSPHERIC CONDITIONS IN THE MAGNETIC STAR HD 133029 ASTROPHYS J 122, 396 (1955) CA 50, 3076 (1956)	601003 601003 601003 601003 601003 601003
BURBRIDGE, E BURBRIDGE, G CHEMICAL COMPOSITION OF THE BARIUM 2 STAR HD 46407 AND ITS BEARING ON ELEMENT SYNTHESIS IN STARS ASTROPHYS J 126, 357 (1957) CA 52, 868 (1958)	601103 601103 601103 601103 601103
BURBRIDGE, G BURBRIDGE, E AN ANALYSIS OF THE MAGNETIC VARIABLE ALPHA SQUARED CANUM VENATICORUM ASTROPHYS J SUPPL SER 1, 431 (1955) CA 49, 9381 (1955)	600929 600929 600929 600929 600929
BURBRIDGE, G BURBRIDGE, E SPECTROPHOTOMETRIC STUDY OF ALPHA SQUARED-CANUM VENATICORUM ASTRON J 59, 318 (1954) CA 49, 714 (1955)	600937 600937 600937 600937
BURDESE, A HEAT OF OXIDATION OF URANIUM OXIDES RICERCA SCI 28, 163 (1958) NSA 13, 1199 (1959)	601560 601560 601560 601560
BURDESE, A BORLERA, M THE SYSTEM ZR02-V205 ANN CHIM (ROME) 50, 1570 (1960)	200945 200945 200945

CA 55, 10172 (1961)	200945
BURG, A	300418
BONDING IN BORON COMPOUNDS AND IN INORGANIC POLYMERS	300418
J CHEM EDUC 37, 482 (1960)	300418
CA 55, 4074 (1961)	300418
BURGER, J TAYLOR, M	600853
ANOMALIES IN THE MAGNETIC SUSCEPTIBILITY AND ELECTRICAL	600853
RESISTIVITY OF VANADIUM	600853
PHYS REV LETTERS 6, 185 (1961)	600853
BURK, D ESTERMANN, I FRIEDBURG, S	200926
(CARNEGIE INST OF TECHNOL PITTSBURGH PA)	200926
THE LOW TEMPERATURE SPECIFIC HEATS OF TI, ZR AND HF	200926
Z PHYSIK CHEM (FRANKFURT) 16, 183 (1958)	200926
CA 55, 8023 (1961)	200926
BURKE, J	601403
PROGRESS IN CERAMIC SCIENCE. VOL 1.	601403
NEW YORK, PERGAMON PRESS, (1961)	601403
NSA 15, 26061 (1961)	601403
BURKE, J DIXON, P	301420
(UNIV LIVERPOOL LIVERPOOL ENGLAND)	301420
THE ALPHA TO BETA AND BETA TO ALPHA PHASE TRANSITION IN	301420
PURE URANIUM	301420
J NUCL MATER 7, 38 (1962)	301420
CA 58, 13550 (1963)	301420
BURKHALTER, J ANDERSON, R SMITH, W GORDY, W	600550
A PRELIMINARY REPORT ON THE FINE STRUCTURE OF THE	600550
MICROWAVE ABSORPTION SPECTRUM OF OXYGEN	600550
PHYS REV 77, 152 (1950)	600550
CA 44, 2851 (1950)	600550
BURKHALTER, J ANDERSON, R SMITH, W GORDY, W	600551
THE FINE STRUCTURE OF THE MICROWAVE ABSORPTION SPECTRUM	600551
OF OXYGEN	600551
PHYS REV 79, 651 (1950)	600551
CA 44, 9803 (1950)	600551
BURKHART, L STUKENBROECKER, G ADAMS, S	601373
ISOTOPE SHIFTS IN URANIUM SPECTRA	601373
PHYS REV 75, 83 (1949)	601373
NSA 2, 891 (1949)	601373
BURNS, J OSBORNE, D WESTERN, E	200848
HEAT CAPACITY OF URANIUM TETRAFLUORIDE FROM 1.3 TO	200848
20 DEGREES K AND THE THERMODYNAMIC FUNCTION TO 300 DEGREES K	200848
CALORIMETER FOR THE RANGE 0.8 TO 20 DEGREES K	200848
J PHYS CHEM 64, 387 (1960)	200848
CA 55, 4135 (1961)	200848
BURRUS, C	600707
STARK EFFECT FROM 1.1 TO 2.6 MM WAVE LENGTH	600707
PH3, PD3, DI AND C0	600707
J CHEM PHYS 28, 427 (1958)	600707
CA 52, 9771 (1958)	600707
BURRUS, C GORDY, W	600735
ONE TO TWO MILLISECOND WAVE SPECTROSCOPY III NO AND DI	600735
PHYS REV 92, 1437 (1953)	600735

CA 48, 4978 (1954)	600735
BURRUS, C GRAYBEAL, J	600736
STARK EFFECT AT 2.0 AND 1.2 MILLIMETERS NITRIC OXIDE	600736
PHYS REV 109, 1553 (1957)	600736
CA 52, 14326 (1958)	600736
BURTSEV, V SAMARIN, A	202012
PRESSURE OF SATURATED VAPORS OF LIQUID METALS AND THEIR	202012
IMPURITIES INVESTIGATED BY THE CARRYING GAS METHOD	202012
ZAV LAB 28, NO 10, 11- 99 (1962)	202012
RUSS ACC 15, NO 10, 2774 JARY (1963)	202012
BURYLEV, B	301071
SOLUBILITY OF CARBON IN LIQUID METALS OF THE FOURTH PERIOD	301071
IZV VUZ CHERNAYA MET (1961)	301071
REV MET LIT 19, (1962)	301071
BUSCH, R	600939
(U BUENOS AIRES BUENOS AIRES ARGENTINA)	600939
X RAY PROOF OF THE DIRECT OXIDATION OF PLATINUM	600939
Z NATURFORSCH 5B, 130 (1950)	600939
CA 44, 8187 (1950)	600939
BUSCH, R	600945
THE OXIDES OF PLATINUM	600945
CIENCIA INVEST (BUENOS AIRES) 7, 243 (1951)	600945
CA 46, 369 (1952)	600945
BUSCOMBE, W MERRILL, P	100199
INTENSITIES OF ATOMIC ABSORPTION LINES IN THE SPECTRA OF LONG	100199
PERIOD VARIABLE STARS	100199
ASTROPHYS J 116, 525 (1952)	100199
CA 47, 3690 (1953)	100199
BUSLAYEV, Y GORBUNOVA, Y	300830
ZIRCONIUM AND HAFNIUM OXYFLUORIDES	300830
IZ AK NAUK SSSR, OTDEL KHIM NAUK NO 2,	300830
195 (1962)	300830
COTS 56, 153 (1962)	300830
BUTCHER, B	601031
(ATOMIC ENERGY RES ESTAB GREAT BRITIAN)	601031
THE BETA PHASE CHANGE IN PURE URANIUM	601031
ATOMIC ENERGY RESEARCH ESTAB M/R 1944, 16 (1956)	601031
CA 51, 1711 (1957)	601031
BUTLER, G HAUSNER, H	200915
DATA BOOK ON URANIUM DIOXIDE	200915
LOS ANGELES, GLADDING MCBEAN + CO (1960)	200915
BUTLER, J MCCABE, C PAXTON, H	700629
THERMODYNAMIC ACTIVITIES IN THE FE-MN-C SYSTEM	700629
TRANS MET SOC OF AIME 221, 479 (1961)	700629
BUTORINA, L	700986
(GORKI STATE UNIVERSITY GORKI USSR)	700986
AN ELECTRON DIFFRACTION STUDY OF THE TUNGSTEN CARBIDE WC	700986
SOVIET PHYS CRYST 5, 216 (1960)	700986
NSA 15, 3137 (1961)	700986
BUZZARD, R LISS, R FICKLE, P	601649
TITANIUM-URANIUM SYSTEM IN THE REGION 0 TO 30	601649

ATOMIC PERCENT TITANIUM	601649
J RES NAT BUR STDS 50, 209 (1953)	601649
BYKOV, V KAZARNIKOV, V	201649
STRUCTURE OF INTERMETALLIC COMPOUNDS OF ZIRCONIUM	201649
KRISTALLOGRAFIYA 4, 924 (1959)	201649
CA 57, 4126 (1962)	201649
CABBAGE, A WELCH, F PRICE, J	601443
THE HEAT CAPACITY OF URANIUM DIOXIDE AS A FUNCTION	601443
OF TEMPERATURE	601443
NEPA-935 (JULY 21, 1949- DECL JULY 18, 1961)	601443
NSA 16, 5305 (1962)	601443
CABANNES, F	301121
FORMATION OF CARBON PARTICLES IN FLAMES AND OBSERVATION OF	301121
THE C3 MOLECULE	301121
JOUR DE PHYSIQUE ET LA RADIUM 17, 492 (1956)	301121
COTS 54, 121 (1962)	301121
CADEVILLE, M MEYER, A	202013
CURIE POINTS AND MOMENTS OF FERMOMAGNETIC BORIDES OF THE	202013
IRON GROUP OF TYPE M2B M-B (M1, M2) 2B AND (M1, M2) B	202013
COMPT REND 255, 3391 (1962)	202013
CA 58, 8508 (1963)	202013
CADY, G HARGREAVES, G	201046
(UNIV OF WASHINGTON SEATTLE WASHINGTON)	201046
THE VAPOR PRESSURE OF SOME HEAVY TRANSITION METAL HEXAFLUORIDES	201046
J CHEM SOC, 1563 (1961)	201046
CA 55, 16048 (1961)	201046
CADY, G HARGREAVES, G	201047
(UNIV OF WASHINGTON SEATTLE WASHINGTON)	201047
VAPOR PRESSURES OF SOME FLUORIDES AND OXYFLUORIDES OF	201047
MOLYBDENUM, TUNGSTEN, RHENIUM, AND OSMIUM	201047
J CHEM SOC, 1568 (1961)	201047
CA 55, 16048 (1961)	201047
CALVERT, E KIRK, M BEALL, R	301421
CHEMICAL REACTIONS IN THE ELECTRIC ARC. REACTIVE METAL	301421
CARBIDES	301421
BUR MINES REPT 5951, (1962)	301421
CAMAC, M VAUGHAN, A	600613
OXYGEN VIBRATION AND DISSOCIATION RATES IN OXYGEN	600613
ARGON MIXTURES	600613
AFRMD-TR-60-22, (1959)	600613
NS 14, 13043 (1960)	600613
CAMERON, A WICHES, E	301422
(NATL RES COUNCIL WASHINGTON DC)	301422
REPORT OF THE INTERNATIONAL COMMISSION OF ATOMIC WEIGHTS	301422
J AM CHEM SOC 84, 4175 (1962)	301422
CA 58, 1915 (1963)	301422
CAMPBELL, T BLOCK, F MUSSLER, R ROBIDART, G	201328
(US BUR OF MINES ALBANY ORE)	201328
PREPARATION AND METALLIC REDUCTION OF RARE EARTH HALIDES AND	201328
OXIDES	201328
US BUR MINES REPT INVEST NO 5882 (1961)	201328
CA 56, 5613 (1962)	201328

CAMPBELL, I ROSENBAUM, D GONSER, B	200867
THE AVAILABILITY, RECOVERY, AND PROPERTIES OF RHENIUM METAL	200867
J LESS-COMMON METALS 1, 185 (1959)	200867
CA 55, 5268 (1961)	200867
CANON, G	301423
RATE OF VOLATILIZATION OF METALS IN A VACUUM BY GRAVIMETRIC	301423
DETERMINATION AT ELEVATED TEMPERATURES	301423
MEM SCI REV MET 59, 878 (1962)	301423
CA 58, 11051 (1963)	301423
CAPLAN, D COHEN, M	700529
THE VOLATILIZATION OF CHROMIUM OXIDE	700529
J ELECTROCHEM SOC 108, 438 (1961)	700529
CARIO, G REINECKE, L	600573
ENERGY OF DISSOCIATION OF NITROGEN MOLECULES AND LUMINOSITY	600573
OF ACTIVE NITROGEN	600573
ANGEW CHEM 62, 48 (1950)	600573
CA 47, 5747 (1953)	600573
CARLSON, G	201229
(UNIV PITTSBURGH PITTSBURGH PA)	201229
THE VIBRATIONAL SPECTRA AND MOLECULAR STRUCTURES	201229
OF INORGANIC COMPOUNDS REO3CL, REO3BR, SI(NC0)4 AND	201229
GE(NC0)4	201229
UNIV MICROFILMS (ANN ARBOR MICH) ORDER NO 61-3255	201229
DISSERTATION ABSTR 22, 749 (1961)	201229
CA 56, 1122 (1962)	201229
CARPENTER, R KATO, H	600626
X-RAY CRYSTALLOGRAPHY OF BORON	600626
BMRI 5636, (1958)	600626
NS 14, 23392 (1960)	600626
CARROLL, K	700662
BERYLLIUM A SURVEY OF THE LITERATURE	700662
AD-253284 (DEC 1960)	700662
GR 36, NO 3, 5 (1961)	700662
CARROLL, P	600552
PREDISSOCIATION IN THE SCHUMANN RUNGE BANDS OF OXYGEN	600552
ASTROPHYS J 129, 794 (1959)	600552
CA 53, 17665 (1959)	600552
CARROLL, D	202014
(GEN ELEC CO RICHLAND WASH)	202014
SYSTEM PU02-ZR02	202014
J AM CERAM SOC 46, 194 (1963)	202014
CA 59, 7226 (1963)	202014
CARROLL, P	600574
A NEW TRANSITION IN MOLECULAR NITROGEN	600574
CAN J PHYSICS 36, 1585 (1958)	600574
CA 53, 1914 (1959)	600574
CARROLL, P	301424
(UNIV CHICAGO CHICAGO ILL)	301424
THE STRUCTURE OF THE GOLDSTEIN-KAPLAN BANDS OF N2	301424
PROC ROY SOC (LONDON) SER A 272, 270 (1963)	301424
CA 58, 7505 (1963)	301424

CARRØLL, P	600677
THE SPECTRUM ØF CN IN THE VACUUM ULTRAVIOLET	600677
CAN J PHYSICS 34, 83 (1956)	600677
CA 50, 3892 (1956)	600677
CARRØLL, P RUBALCAVA, H	600572
NEAR INFRARED SYSTEM ØF NITRØGEN	600572
NATURE 184, 119 (1959)	600572
CARRØLL, P RUBALCAVA, H	600693
RØTATIONAL ANALYSIS ØF THE 5-1 BAND ØF THE B PRIME-B	600693
SYSTEM ØF N2	600693
PRØC PHYS SØC (LØNDØN) 76, 337 (1960)	600693
PA 64, 2315 (1960)	600693
CARRØLL, P SAYERS, N	600545
THE BAND SPECTRUM ØF NITRØGEN NEW STUDIES ØF THE TRIPLET	600545
SYSTEMS	600545
PRØC PHYS SØC LØNDØN 66A, 1138 (1953)	600545
CA 48, 6250 (1954)	600545
CARTER, J DAANE, A	400560
FØRMING URANIUM CARBIDES	400560
US PATENT 2526805 (1950)	400560
CA 45, 107 (1951)	400560
CARTER, J DAANE, A	400561
URANIUM CARBIDE	400561
US PATENT 2569225 (1951)	400561
CA 46, 405 (1952)	400561
CARTER, W	300749
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	300749
THERMODYNAMIC PROPERTIES ØF SEVEN METALS AT ZERO PRESSURE	300749
USAFEC LAMP-2640 62 (1962)	300749
CA 57, 4111 (1962)	300749
CASH, A HUGHES, F MURDOCK, C	201352
(CØRNELL UNIV ITHACA NY)	201352
STRUCTURE ØF CRYSTALLINE URANIUM	201352
ACTA CRYST 14, 313 (1961)	201352
CA 56, 6738 (1962)	201352
CASSEDANNE, J FØRESTIER, H	700801
EQUILIBRIUM DIAGRAM ØF THE SYSTEM - LANTHANUM ØXIDE - YTTRIUM	700801
ØXIDE	700801
CØMPT REND 253, 2953 (1961)	700801
CA 56, 10981 (1962)	700801
CATALAN, M RICO, F	601206
SERIES AND IØNIZATION PØTENTIALS IN THE MIII SPECTRA	601206
ØF THE ELEMENTS ØF THE PD GRØUP	601206
ANALES REAL SØC ESPAN FIZ Y QUIM 53A, 85 (1957)	601206
CA 54, 2929 (1960)	601206
CATALAN, M RICO, F	700800
SERIES AND IØNIZATION PØTENTIALS IN THE FIRST AND SECOND	700800
SPECTRA ØF THE PALLADIUM GRØUP ELEMENTS	700800
ANNALES REAL SØC ESPAN FIS Y QUIM 48A, 328 (1952)	700800
CA 48, 6830 (1954)	700800
CAUCHØIS, Y	100210
ENERGY LEVELS ØF HEAVY ATØMS	100210

J PHYS RADIUM 13, 113 (1952)	100210
CA 47, 400 (1953)	100210
CAUCHOIS, Y	301102
ENERGY LEVELS OF THE ATOMS WITH Z BELOW 70	301102
J PHYS RADIUM 16, 253 (1955)	301102
CA 49, 12107 (1955)	301102
CAVALLERØ, U	700895
A NEW METHOD OF DETERMINING THE HEAT OF FUSION FROM COOLING	700895
CURVES I COOLING CURVES OF LA, CE, PR, AND AL	700895
ATTI ACCAD ITALIA, REND NØ 7, 4, 520 (1943)	700895
CA 41, 7223 (1943)	700895
CAVELL, R CLARK, H	201725
(UNIV BRITISH COLUMBIA VANCØUVER CANADA)	201725
PREPARATION AND PROPERTIES OF VANADIUM TETRAFLUØRIDE	201725
J CHFM SOC 1962, 2692	201725
CA 57, 5556 (1962)	201725
CERVONE, E FURLANI, C	201521
(UNIV RØME RØME ITALY)	201521
ANN CHIM (RØME) 51, 838 (1961)	201521
SØME OBSERVATIONS ON THE LOWEST VALENCIES OF TITANIUM	201521
CA 56, 13746 (1962)	201521
CHADWICK, U	202015
BIBLIOGRAPHY ON THE PRODUCTION AND PROPERTIES OF SILICON	202015
CARBIDE	202015
UK AT ENERGY AUTHORITY TRG INFORM SER 295, 37 (1963)	202015
CA 59, 8348 (1963)	202015
CHAKLADER, A	301426
(UNIV BRIT COLUMBIA VANCØUVER CAN)	301426
X-RAY STUDY QUARTZ-CRISTØBALITE TRANSFØRMATION	301426
J AM CERAM SOC 46, 66 (1963)	301426
CA 58, 11075 (1963)	301426
CHAKLADER, A	301425
(UNIV BRIT COLUMBIA VANCØUVER CAN)	301425
GEOMETRIC METHODS FOR QUARTZ-CRISTØBALITE TRANSFØRMATION	301425
J AM CERAM SOC 46, 192 (1963)	301425
CA 59, 5868 (1963)	301425
CHAKLADER, A	301201
X-RAY STUDY OF QUARTZ-CRISTØBALITE TRANSFØRMATION	301201
J AM CERAMIC SOC 46, 66 (1963)	301201
CHAMBERLAIN, J	600542
THE BLUE AIRGLOW SPECTRUM	600542
ASTROPHYSICS J 128, 713 (1958)	600542
CA 52, 5860 (1959)	600542
CHAMBERS, R	300819
THE INVERSION OF SPECIFIC HEAT CURVES	300819
PROC PHYS SOC (6B) 79, 941 (1961)	300819
PA 65, 570 (1962)	300819
CHANDRASEKHAR, B	601098
THE ANOMALOUS THERMAL EXPANSION OF SOME RARE EARTH METALS	601098
ACTA MET 6, 212 (1958)	601098
CA 52, 7798 (1958)	601098

CHANEY, W	701068
(NASA LANGLEY RES CENTER LANGLEY FIELD VA)	701068
A METHOD FOR THE CALCULATION OF LATTICE ENERGIES OF COMPLEX	701068
CRYSTALS WITH APPLICATION TO THE OXIDES OF MOLYBDENUM	701068
NASA-TR-R-112 (1961)	701068
NSA 15, 27598 (1961)	701068
CHAPMAN, A	200810
INVESTIGATION OF THE SI-O-C SYSTEM, INCLUDING COMPATIBILITY	200810
RELATIONS, KINETICS OF REACTIONS, AND EQUILIBRIUM INFORMATION	200810
UNIV MICROFILMS (ANN ARBOR, MICH), L C CARD NO MICH 60-2113,	200810
DISSERTATION ABSTR 21, 141 (1960)	200810
CA 55, 2248 (1961)	200810
CHAPMAN, A T	202016
VOLATILITY OF V ₂ O ₅ PLUS X AND PHASE RELATIONS IN THE	202016
URANIUM-OXYGEN SYSTEM	202016
PAPER 1-25-63 OF 65TH ANNUAL MEETING OF AM CERAM SOC	202016
PITTSBURGH PA APRIL 29, (1963)	202016
CERAMIC BULLETIN 42, 263 (1963)	202016
CHAPMAN, A ST PIERRE, G FOSTER, W SHEVLIN, T	301427
(OHIO STATE UNIV COLUMBUS OHIO)	301427
THE STABLE PHASE OF SILICON MONOXIDE	301427
U S DEPT COM OFFICE TECH SERV P B REPT 154415 (1963)	301427
CA 58, 7586 (1963)	301427
CHAPMAN, M	701005
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	701005
TIN OXIDES AND TITANIUM OXIDES, UNCLASSIFIED BIBLIOGRAPHY	701005
NAA-SR-5729 (1960)	701005
NSA 15, 9332 (1961)	701005
CHARLES, G	601084
A COMPILATION OF DATA ON SOME SPECTRA OF THORIUM	601084
US ATOMIC ENERGY COMM ORNL-2319, 162 (1958)	601084
CA 52, 14322 (1958)	601084
CHARLTON, M DAVIS, G	700513
ALLOTROPES OF TUNGSTEN	700513
NATURE 175, 131 (1955)	700513
CA 49, 4482 (1955)	700513
CHASE, G	201826
(GEN ELEC CO CINCINNATI OHIO)	201826
ON THE EXISTENCE OF A COMPOUND IN THE SYSTEM YTTRIUM-URANIUM-	201826
OXYGEN	201826
ACTA CRYST 15, 91 (1962)	201826
CA 57, 10613 (1962)	201826
CHASTON, J	300577
TEMPERATURE COEFFICIENT OF ELECTRICAL RESISTANCE OF	300577
HIGH-PURITY RHODIUM	300577
NATURE 195, 793 (1962)	300577
CHASTON, J	900941
PROGRESS IN PRECIOUS METALS	900941
METALLURGIA 42, 310 (1950)	900941
CA 45, 1480 (1951)	900941
CHAUDRON, G	700557
NEW CHEMICAL AND PHYSICAL PROPERTIES OF METALS OF VERY HIGH	700557
PURITY OBTAINED BY ZONE-MELTING	700557

BULL SOC CHIM FRANCE, 18 (1961)	700557
CHAUVENET, E	900109
THE STUDY OF HALOGENATED AND OXYHALOGENATED DERIVATIVES OF THORIUM	900109
ANN CHIM PHYS 23, 425 (1911)	900109
CA 6, 45 (1912)	900109
CHEKHOVSKOI, V	600633
HEAT CAPACITY AND ENTHALPY OF MOLYBDENUM IN THE TEMPERATURE INTERVAL 0-2500 DEGREES C	600633
INZH FIZ ZH AKAD NAUK BELORUSSK SSR 5, NO 6, 43 (1962)	600633
CHEKHOVSKOI, V	701074
(MOSCOW ELECT INST MOSCOW RUSSIA)	701074
HEAT CAPACITY AND ENTHALPY OF CORDUM IN THE TEMPERATURE INTERVAL FROM 500 TO 2000 DEGREES C	701074
INZH-FIZ ZH AKAD NAUK BELORUSSK SSR 5, 62 (1962)	701074
NSA 17, 2980 (1963)	701074
CHEKHOVSKOY, V SHUMYATSKY, B YAKIMOVICH, K	300868
TUNGSTEN ENTHALPY IN THE TEMPERATURE RANGE FROM 350 TO 2000 DEGREES C	300868
INZH FIZ ZH AKAD NAUK BELORUSCH SSR 5, NO 10, 13 (1962)	300868
CHEN, M CHIANG, S	301428
SYNTHESIS OF ARTIFICIAL DIAMONDS	301428
HUA HSUEL TUNG PAO 487 (1962)	301428
CA 58, 4195 (1963)	301428
CHENG, C GUPTA, K RENTH, E VANBECK, P	300760
LOW TEMPERATURE SPECIFIC HEAT OF BODY-CENTERED CUBIC TITANIUM-VANADIUM ALLOYS	300760
PHYS REV 126, NO 6, 2030 (1962)	300760
CHERON, T	301429
BERYLLIUM OXIDE A LITERATURE SURVEY	301429
AD 269729 (1961)	301429
CHIANG, T	201680
(UNIV WISCONSIN MADISON WISCONSIN)	201680
THE REDUCED STATES OF THE GROUP IV TRANSITIONAL ELEMENTS	201680
UNIV MICROFILMS (ANN ARBOR MICH) ORDER NO 62-1957,	201680
DISSERATION ABSTR 22, 3381 (1962)	201680
CA 57, 4267 (1962)	201680
CHIKALLA, T	301203
MELTING BEHAVIOR IN THE SYSTEM V02-PU02	301203
J AM CERAM SOC 46, 323 (1963)	301203
CHERKASHIN, Y GLADISHEVSKIY, I KRIPYAKEVICH, P	301107
COMPOUNDS OF TRANSITION METALS AND BERYLLIUM SILICON	301107
GERMANIUM AND TIN	301107
DOP LVIV DERZHAV, UNIV IMENI I FRANKA , NO 3, 180 (1957)	301107
COTS 54, 238 (1962)	301107
CHIOTTI, P	100204
THORIUM-CARBON SYSTEM	100204
IOWA STATE COLL J SCI 26, 185 (1952)	100204
AECD-3072 ISC-103 (1950)	100204
CA 47, 2026 (1953)	100204
NSA 5, 3141 (1951)	100204

CHIOTTI, P	601416
SUMMARY OF RESEARCH ON EXPERIMENTAL REFRACTORIES	601416
BODIES OF THE HIGH MELTING NITRIDES CARBIDES AND URANIUM	601416
DIOXIDE	601416
AFCD-3204 ISC-44 (1949)	601416
NSA 5, 4416 (1951)	601416
CHIOTTI, P	601198
(IOWA STATE COLL AMES IOWA)	601198
HIGH-TEMPERATURE CRYSTAL STRUCTURE OF THORIUM	601198
J ELECTROCHEM SOC 101, 567 (1954)	601198
CA 50, 20 (1956)	601198
CHIOTTI, P	601227
HIGH TEMP CRYSTAL STRUCTURE OF THORIUM	601227
(CONTRACT W-7405-ENG-82 (ISC-481) (1954)	601227
NSA 8, 4338 (1954)	601227
CHIOTTI, P	601237
EXPERIMENTAL REFRACTORY BODIES OF HIGH-MELTING NITRIDES	601237
CARBIDES AND URANIUM DIOXIDE	601237
J AM CERAM SOC 35, 123 (1952)	601237
NSA 6, 3566 (1952)	601237
CHIOTTI, P	601324
(AMES LAB AMES IOWA)	601324
HANFORD SIUG SEMI-ANNUAL REPT JAN 1-JUN 30, 1956,	601324
ISC-761	601324
NSA 11, 1877 (1957)	601324
CHIOTTI, P GILL, K	700624
PHASE DIAGRAM AND THERMODYNAMIC PROPERTIES OF THE THORIUM-	700624
ZINC SYSTEM	700624
TRAN MET SOC AIME 215, 573 (1961)	700624
CT NO 13, (1961)	700624
CHIOTTI, P KLEPPER, H WHITE, R	601074
LATTICE PARAMETERS OF URANIUM FROM 25 TO 1132C	601074
TRANS AM SOC METALS PREPRINT NO 83, 12 (1958)	601074
CA 52, 19807 (1958)	601074
CHIPMAN, J	201050
(MASS INST OF TECHNOL CAMBRIDGE MASS)	201050
THE FREE ENERGY OF SILICA	201050
J AM CHEM SOC 83, 1762 (1961)	201050
CA 55, 16114 (1961)	201050
CHISWICK, H DWIGHT, A LLÖYD, L NEVITT, M ZEGLER, S	601207
ADVANCES IN THE PHYSICAL METALLURGY OF URANIUM AND ITS	601207
ALLOYS	601207
PROC U N INTERN CONF PEACEFUL USES AT ENERGY 2ND GENEVA	601207
6, 394 (1958)	601207
CA 54, 1225 (1960)	601207
CHODURA, B MALY, J	601546
A CONTRIBUTION TO THE SOLUTION OF THE STRUCTURE OF U3O8	601546
A/CONF 15/P/2099	601546
NSA 13, 6406 (1959)	601546
CHRETIEN, A DUHART, P	300536
THE MAGNESIUM BORIDES. THEIR THERMAL RELATIONSHIP	300536
COMPT REND 254, NO 8, 1439 (1962)	300536
BHT NO 2, 33 (1962)	300536

CHRETIEN, A HELGØRSKY, J	201084
(UNIV SØRBØNNE PARIS FRANCE)	201084
BORIDES OF MOLYBDENUM AND TUNGSTEN, MØB4 AND WB4, NEW COMPOUNDS	201084
COMPT REND 252, 742 (1961)	201084
CA 55, 17330 (1961)	201084
CHRISTIAN, J	601521
(UNITED KINGDOM AT ENERGY HARWELL ENGLAND)	601521
THE GAMMA TO ALPHA TRANSFORMATION IN URANIUM ALLOYS	601521
AERE-M/R-1811	601521
NSA 13, 19210 (1959)	601521
CHRISTIAN, R DUFF, R YARGER, F	600575
EQUATION OF STATE OF GASES BY SHOCK WAVE MEASUREMENTS	600575
II THE DISSOCIATION ENERGY OF NITROGEN	600575
J CHEM PHYS 23, 2045 (1955)	600575
CA 50, 3027 (1956)	600575
CHUBB, W DICKERSON, R	601481
(BMT COLUMBUS OHIO)	601481
PROPERTIES OF URANIUM CARBIDES	601481
AM CERAM SOC BULL 41, 564 (1962)	601481
CHUBB, W PHILLIPS, W	601442
(BATTELLE MEM INST COLUMBUS OHIO)	601442
CONSTITUTION OF THE PARTIAL SYSTEM. URANIUM	601442
MONOCARBIDE-URANIUM DICARBIDE	601442
TRANS AM SOC METALS 53, 465 (1961)	601442
NSA 16, 2255 (1962)	601442
CHUBB, W TOWNLEY, C GETZ, R	201311
(BATTELLE MEM INST COLUMBUS OHIO)	201311
DIFFUSION COEFFICIENTS OF URANIUM AND CARBON IN URANIUM	201311
MONOCARBIDE	201311
US AT ENERGY COMM BMI-1551 (1961)	201311
CA 56, 414 (1962)	201311
CHUPKA, W BERKOWITZ, J GIESE, C INGRAM, M	700866
THERMODYNAMIC STUDIES OF SOME GASEOUS METALLIC CARBIDES	700866
J PHYS CHEM 62, 611 (1958)	700866
CA 52, 13394 (1958)	700866
CHUPKA, W BERKOWITZ, J MESCHI, D	700892
(ANL LEMONT ILL)	700892
THERMODYNAMIC PROPERTIES OF THE WATER-BORIC OXIDE AND WATER-	700892
LITHIUM OXIDE SYSTEMS BY MASS SPECTROMETRIC METHODS	700892
PROCEEDINGS OF PROPELLANT THERMODYNAMICS AND HANDLING CONF	700892
(1959) OHIO STATE UNIV	700892
NSA 15, 1421 (1961)	700892
CHUPKA, W INGRAM, M PORTER, R	700925
DISSOCIATION ENERGY OF GASEOUS LAO	700925
J CHEM PHYS 24, 792 (1956)	700925
CA 50, 11101 (1956)	700925
CLAASSEN, H SELIG, H MALM, J	201854
(ARGONNE NATL LAB LEMONT ILL)	201854
VIBRATIONAL SPECTRA OF MOF6 AND TCF6	201854
J CHEM PHYS 36, 2888 (1962)	201854
CA 57, 11983 (1962)	201854
CLAASSEN, H MALM, J SELIG, H	201855

(ARGONNE NATL LAB	LEMONT	ILL)	201855
VIBRATIONAL SPECTRA OF REF6			201855
J CHEM PHYS 36, 2890 (1962)			201855
CA 57, 11986 (1962)			201855
CLARK, A STRAKNA, R			300580
THE LOW-TEMPERATURE EXCESS SPECIFIC HEAT OF SILICON			300580
DIOXIDE GLASS			300580
PHYS CHEM GLASSES 3, NO 4, 121 (1962)			300580
CT NO 17, 93 (1962)			300580
CLARK, C			601563
(SOUTHERN METHODIST UNIV		TEXAS)	601563
CALCULATED LATTICE SPECIFIC HEATS FOR SEVEN BODY-CENTERED			601563
CUBIC ELEMENTS			601563
PHYS REV 125, 1898 (1962)			601563
CLAUS, H ULMER, K			202017
STUDY OF THE ENERGY BAND STRUCTURE OF TANTALUM NIOBIUM			202017
TUNGSTEN AND MOLYBDENUM WITH ISO CHROMATE MEASUREMENTS			202017
AND MOLYBDENUM WITH ISO CHROMATE MEASUREMENTS			202017
Z PHYSIK 173, 462 (1963)			202017
CLAYTON, J ARONSON, S			601122
(WESTINGHOUSE ELEC. CO.	PITTSBURG	PA)	601122
DENSITIES OF URANIUM OXIDE IN THE REGION UO2-U4O9			601122
US AT ENERGY COMM WAPD-BT-10, 96 (1958)			601122
CA 53, 8788 (1959)			601122
CLEMENTI, F			300815
ELECTRONIC STATE IN THE C4 MOLECULE			300815
J AM CHEM SOC 83, 4501 (1961)			300815
PA 65, 2005 (1962)			300815
CLEMENTI, E			301204
(IBM SAN JOSE RES LAB	SAN JOSE	CALIF)	301204
DISSOCIATION ENERGY COMPUTATIONS IN DIATOMIC MOLECULES			301204
AN EXAMPLE			301204
J CHEM PHYS 38, 2780 (1963)			301204
CLEMENTI, E MCLEAN, A			300814
SCF-LCAO-MO WAVE FUNCTION FOR THE GROUND STATE OF C3			300814
J CHEM PHYS 36, NO 1, 45 (1962)			300814
PA 65, 2014 (1962)			300814
CLIFTON, D MACWOOD, G			300292
THERMODYNAMICS OF THE TITANIUM CHLORIDES			300292
I HEAT OF FORMATION OF TiCl3			300292
J PHY CHEM 60, 309 (1956)			300292
CLOUD, W SCHREIBER, D BABCOCK, K			201931
(E I DUPONT DE NEMOURS AND CO WILMINGTON		DEL)	201931
X-RAY AND MAGNETIC STUDIES OF CrO2 SINGLE CRYSTALS			201931
J APPL PHYS 33, 1193 (1962)			201931
CA 57, 15923 (1962)			201931
CLOUGHERTY, E OTHROP, K KAFALAS, J			600843
A NEW PHASE FORMED BY HIGH-PRESSURE TREATMENT, FACE-CENTERED			600843
CUBIC MOLYBDENUM MONOCARBIDE			600843
NATURE 191, 1194 (1961)			600843
CLUSIUS, K FRANZOSINI, P			200927
(UNIV ZURICH	ZURICH	SWITZERLAND)	200927

LOW-TEMPERATURE RESEARCH XIX ATOMIC AND ELECTRONIC HEAT CAPACITIES OF TITANIUM BETWEEN 13 AND 273 DEGREES K	200927
Z PHYSIK CHEM (FRANKFURT) 16, 194 (1958)	200927
CA 55, 8024 (1961)	200927
CLUSIUS, K FRANZOSINI, P	601038
(UNIV ZURICH ZURICH SWITZ)	601038
THE ATOMIC AND ELECTRONIC HEATS OF THORIUM	601038
Z NATURFORSCH 11A, 957 (1956)	601038
CA 51, 4117 (1957)	601038
CLUSIUS, K FRANZOSINI, P	301051
(UNIV OF ZURICH)	301051
LOW TEMPERATURE RESEARCH	301051
THE ATOMIC AND ELECTRONIC HEAT OF CR BETWEEN 24K AND 273K	301051
Z NATURFORSCH 17, 522 (1962)	301051
CA 57, 10592 (1962)	301051,
CLUSIUS, K FRANZOSINI, P PIESBERGEN, U	700987
(UNIVERSITAT ZURICH SWITZ)	700987
RESULTS OF LOW TEMPERATURE RESEARCH, XXXII, THE ATOMIC AND	700987
ELECTRON HEAT OF V AND Nb BETWEEN 10 DEGREES AND 273 DEGREES K	700987
Z NATURFORSCH 15A, 728 (1960)	700987
NSA 15, 3280 (1961)	700987
CLUSIUS, K LOSA, C	601039
LOW TEMPERATURE RESEARCH XIV ATOMIC AND ELECTRONIC HEATS	601039
OF RHODIUM AND IRIDIUM BETWEEN 10 DEG AND 273 DEG K	601039
Z NATURFORSCH 10A, 545 (1957)	601039
CA 51, 4118 (1957)	601039
CLUSIUS, K LOSA, C FRANZOSINI, P	601101
LOW TEMPERATURE RESEARCH 18 ATOMIC AND ELECTRONIC HEAT OF	601101
PLATINUM BETWEEN 10 AND 273 K	601101
Z NATURFORSCH 12A, 34 (1957)	601101
CA 51, 10215 (1957)	601101
CLUSIUS, K PIESBERGEN, U	601119
ATOMIC AND ELECTRONIC HEAT CAPACITY OF URANIUM BETWEEN 10 DEG	601119
K AND ROOM TEMPERATURE	601119
HELV PHYS ACTA 31, 302 (1958)	601119
CA 53, 4881 (1959)	601119
CÖCCO, A	201168
COMPOSITION LIMITS AT HIGH TEMPERATURES OF THE	201168
CUBIC PHASE COMPOSED OF ZR02 AND CA0	201168
CHIM E IND 41, 882 (1959)	201168
CA 55, 22960 (1961)	201168
CÖCCO, A BARBARIOL, I	301430
(UNIV TRIESTE TRIESTE ITALY)	301430
THE ELECTRICAL CONDUCTIVITY OF OXIDES AT ELEVATED	301430
TEMPERATURES	301430
RIC SCI REND SEZ A 2, NO 3, 296 (1962)	301430
CA 58, 7462 (1963)	301430
CÖCCO, A SCHRÖMEK, N	201637
(UNIV TRIESTE ITALY)	201637
SUBSOLIDES PHASE RELATIONS IN THE SYSTEM MG0-ZR02-TI02	201637
ANN CHIM (ROME) 51, 1194 (1961)	201637
CA 57, 4094 (1962)	201637
CÖCCO, A SCHRÖMEK, N	201188

(UNIV TRIESTE	TRIESTE	ITALY)	201188
THE ZR02-TI02-SI02 SYSTEM			201188
CHIM E IND (MILAN) 42, 480 (1960)			201188
CA 56, 58 (1962)			201188
C0CC0, A SCHR0MEK, N			201211
(UNIV TRIESTE	TRIESTE	ITALY)	201211
CUBIC-STRUCTURE SOLID SOLUTIONS OF MG0 AND ZR02			201211
RADEX RUNDSCHAU 1961, 590 (1961)			201211
CA 56, 986 (1962)			201211
C0CC0, A VIRDIS, P			201316
PHASE RELATIONS IN THE SOLID STATE IN THE SYSTEM CA0-ZR02-TI02			201316
CHIM E IND (MILAN) 43, 1115 (1961)			201316
CA 56, 5447 (1962)			201316
C0CHRAN, J			201877
(MIT	CAMBRIDGE	MASS)	201877
SPECIFIC HEAT OF TANTALUM AND TIN NEAR THE SUPERCONDUCTING			201877
CRITICAL TEMPERATURE			201877
ANN PHYS (N.Y.) 19, 186 (1962)			201877
CA 57, 13234 (1962)			201877
C0CHRAN, C F0STER, L			300395
THE STABILITY OF SILICA			300395
J PHYS CHEM 66, 380 (1962)			300395
C0DLING, K			600775
ULTRAVIOLET EXTENSIONS OF THE ARC SPECTRA OF THE ALKALINE			600775
EARTHS. THE ABSORPTION SPECTRUM OF MAGNESIUM VAPOR			600775
PROC PHYS SOC (LONDON) 77, 797 (1961)			600775
CA 55, 13043 (1961)			600775
C0EFFIER, G TRA0RE, K BRENET, J			700648
TRANSFORMATIONS OF THE STRUCTURE OF ANHYDROUS AND HYDRATED			700648
RHENIUM DIOXIDE			700648
COMPT REND 253, 103 (1961)			700648
CT NO 16, (1961)			700648
C0FFMAN, J C0ULSON, K KIBLER, G			701006
(GE FLIGHT PROPULSION LAB	CINCINNATI	OHIO)	701006
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH			701006
PROGRAM			701006
NP-9791 (1960)			701006
NSA 15, 9419 (1961)			701006
C0FFMAN, J C0ULSON, K KIBLER, G			701040
(GE FLIGHT PROPULSION LAB	CINCINNATI	OHIO)	701040
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH			701040
PROGRAM			701040
NP-10151 (1961)			701040
NSA 15, 19844 (1961)			701040
C0FFMAN, J KIBLER, G RIETH0F, T WATT, A			700985
(GE FLIGHT PROPULSION LAB	CINCINNATI	OHIO)	700985
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH			700985
PROGRAM			700985
WADD TR-60-646, (1960)			700985
AD-236160 (1960)			700985
NSA 15, 5381 (1961)			700985
NSA 15, 3070 (1961)			700985
C0FFMAN, J KIBLER, G RIETH0F, T WATTS, A			700993

(GE FLIGHT PROPULSION LAB CINCINNATI OHIO)	700991
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH	700992
WADD-TR-60-646 (1960)	700993
NSA 15, 5381 (1961)	700993
CÖHAN, N PUGH, D TREDGÖLD, R	301431
(UNIV CÖLL N WALES BANGÖR ENGLAND)	301431
BAND STRUCTURE OF DIAMÖND	301431
PRÖC PHYS SÖC (LÖNDÖN) 82 (525), PT 1, 65 (1963)	301431
CA 59, 3434 (1963)	301431
CÖHEN, I SCHANER, B	202018
(BETTIS AT PÖWER LAB PITTSBURGH PA)	202018
A METALLÖGRAPHIC AND X-RAY STUDY OF THE UÖ2-ZRÖ2 SYSTEM	202018
J NUCL MATER NÖ9, 18 (1963)	202018
CA 59, 8173 (1963)	202018
CÖHEN, I SCHANER, B	201845
(BETTIS AT PÖWER LAB PITTSBURGH PA)	201845
A METALLÖGRAPHIC AND X-RAY STUDY OF THE UÖ2-ZRÖ2 SYSTEM	201845
US AT ENERGY CÖMM WAPD-253, (1962)	201845
CA 57, 11910 (1962)	201845
CÖLES, B	601498
(IMPERIAL CÖLL LÖNDÖN ENGLAND)	601498
SPIN-DISÖRDER EFFECTS IN THE ELECTRICAL RESISTIVITIES	601498
OF METALS AND ALLÖYS	601498
ADVANCES IN PHYS 7, 40 (1958)	601498
NSA 12, 8497 (1958)	601498
CÖLLIGAN, G GALASSÖ, F	600860
STRUCTURE OF VAPÖUR-DEPÖSITED CARBÖN	600860
NATURE 190, 621 (1961)	600860
PA 64, 11564 (1961)	600860
CÖLLINS, M	300870
LATTICE DYNAMICS OF MAGNESIUM	300870
PRÖC PHYS SÖC (LÖNDÖN) 80, PT 2 362 (1962)	300870
CÖLLÖNGUES, R	201212
PHASE DIAGRAMS OF ZIRCÖNIA-RARE EARTH ÖXIDE SYSTEMS	201212
BULL SÖC CHIM FRANCE 1961, 70 (1961)	201212
CA 56, 986 (1962)	201212
CÖLLÖNGUES, R GILLES, J LEJUS, A	301205
ACTION OF AMMÖNIA ÖN SÖME SUPER-REFACTÖRY ÖXIDES	301205
BULL SÖC CHIM FRANCE 2113 (1962)	301205
BHT NÖ 2 42 (1963)	301205
CÖLTÖN, E	700609
BÖRÖN-SILICÖN REACTION	700609
INÖRG AND NUCLEAR CHEM 17, 108 (1961)	700609
CÖLTÖN, R	201684
(AT ENERGY RES ESTAB HARWELL ENGLAND)	201684
RHENIUM HEXACHLÖRIDE	201684
NATURE 194, 374 (1962)	201684
CA 57, 4269 (1962)	201684
CÖLTÖN, R	201683
(AT ENERGY RES ESTAB HARWELL ENGLAND)	201683
THE BRÖMIDES AND ÖXIDE BRÖMIDES OF RHENIUM	201683
J CHEM SÖC 1962, 2078	201683

CA 57, 4268 (1962)	201683
COLVIN, R ARAJS, S	301035
(U S STEEL CORP RES CENTER MONROEVILLE PA)	301035
ELECTRICAL RESISTIVITY OF SCANDIUM	301035
J APPL PHYS 34, 286 (1963)	301035
CA 58, 5121 (1963)	301035
COLVIN, R ARAJS, S PECK, J	600875
PARAMAGNETIC BEHAVIOR OF METALLIC CERIUM AND EUROPIUM	600875
PHYS REV 122, 14 (1961)	600875
COLVIN, R LEGVOLD, S SPEDDING, F	601389
(AMES LAB AMES IOWA)	601389
ELECTRICAL RESISTIVITY OF THE HEAVY RARE EARTH METALS	601389
PHYS REV 120, 741 (1960)	601389
NSA 15, 3134 (1961)	601389
COMBARIEN, A D COSTA, P MICHEL, J C	301206
SPECIFIC HEAT OF URANIUM MONOCARBIDE AT LOW TEMPERATURES	301206
COMPT REND 256, 5518 (1963)	301206
COMSA, G GELBERG, A IOSIFESCU, B	700940
(INST OF ATOMIC PHYSICS BUCHAREST ROMANIA)	700940
TEMPERATURE DEPENDENCE OF THE WORK FUNCTION OF METALS	700940
PHYS REV 122, 1091 (1961)	700940
NSA 15, 18546 (1961)	700940
COMSTOCK, M	600623
PROPERTIES OF REFRACTORY NUCLEAR MATERIALS	600623
TID 3906, (1960)	600623
NS 14, 22034 (1960)	600623
CONLON, D DOYLE, W	201325
(UNIV COLL DUBLIN IRE)	201325
ABSORPTION SPECTRA OF VANADIUM, NIOBIUM, AND TANTALUM	201325
PENTOXIDES	201325
J CHEM PHYS 35, 752 (1961)	201325
CA 56, 5538 (1962)	201325
CONNICK, R	400528
OXIDATION STATES OF THE RARE EARTH AND ACTINIDE ELEMENTS	400528
J CHEM SOC 1949, 2, 235 (1949)	400528
CA 44, 8274 (1950)	400528
CONNOLLY, A MENDELSSOHN, K	201535
(UNIV OXFORD OXFORD ENGLAND)	201535
THERMAL CONDUCTIVITY OF TANTALUM AND NIOBIUM BELOW 1 DEGREES K	201535
PROC ROY SOC (LONDON) 266, 429 (1962)	201535
CA 56, 14953 (1962)	201535
CONNOLLY, D	601365
(U.K. AT ENERGY LANCS ENGLAND)	601365
A NEW INTERPRETATION OF THE X-RAY	601365
DIFFRACTION PATTERN OF MALLINCKRODT UO3	601365
ACTA CRYST 12, 949 (1959)	601365
NSA 14, 2744 (1960)	601365
COOPER, A	601464
(BELL LABS MURRAY HILL N JERSEY)	601464
PRECISE LATTICE CONSTANTS OF GERMANIUM, ALUMINUM,	601464
GALLIUM, ARSENIDE, URANIUM, SULPHUR, QUARTZ AND SAPPHIRE	601464
ACTA CRYST 15, 578 (1962)	601464

NSA 16, 20380 (1962)	601464
COOPER, J R HANSLER, R L	301207
(G E CLEVELAND OHIO)	301207
VARIATION OF ELECTRICAL RESISTIVITY OF CUBIC TANTALUM CARBIDE	301207
WITH COMPOSITION	301207
J CHEM PHYS 39, 248 (1963)	301207
COOPER, T SRP, O	202019
(WRIGHT-PATTERSON AFB DAYTON OHIO)	202019
REFRACTORY METALS AND THEIR PROTECTION	202019
AEROSPACE ENG 22, 46 (1963)	202019
CA 58, 8747 (1963)	202019
CORDFUNKE, E	201785
(REACTOR CENTER NETHERLANDS)	201785
ALPHA UO3 PREPARATION AND THERMAL STABILITY	201785
J INORG NUCL CHEM 23, 285 (1961)	201785
CA 57, 8161 (1962)	201785
CORDFUNKE, E MEYER, G	301054
(LAB GEN INORG CHEM DELFT NETH)	301054
THE SYSTEM IRIIDIUM OXYGEN I MEASUREMENTS ON THE VOLATILE	301054
OXIDE OF IRIIDIUM	301054
REC TRAV CHIM 81, 495 (1962)	301054
CA 57, 11915 (1962)	301054
CORDFUNKE, E MEYER, G	300572
THE SYSTEM IRIIDIUM-OXYGEN II THE DISSOCIATION PRESSURE OF IR02	300572
REC. DE TRAVAUX CHIM. DES PAYS. BAS 81, 670 (1962)	300572
CORNMAN, W	301030
(E I DU PONT DE NEMOURS + CO AIKEN S CAR)	301030
POLYMORPHS OF UO3. CONVERSION TO UF4	301030
U S AT ENERGY COMM DP-750 (1962)	301030
CA 58, 5240 (1963)	301030
CORNWELL, J	700667
(IMPERIAL COLL LONDON ENGLAND)	700667
ELECTRONIC ENERGY BANDS OF THE ALKALI METALS AND METALLIC	700667
BERYLLIUM	700667
PROC ROY SOC (LONDON) 261A, 551 (1961)	700667
CT NO 15, (1961)	700667
NSA 15, 21307 (1961)	700667
CORTER, W	601631
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	601631
THERMODYNAMIC PROPERTIES OF SEVEN METALS AT ZERO PRESSURE	601631
LAMS-2640 (1961)	601631
NSA 16, 19354 (1962)	601631
COST, J	201781
(UNIV ILL URBANA ILL)	201781
EMISSIONS OF NI0BIUM AND NI0BIUM-NITROGEN SOLID SOLUTIONS	201781
TRANS AIME 224, 634 (1962)	201781
CA 57, 8075 (1962)	201781
COST, J WERT, C	301432
(UNIV OF ILLINOIS URBANA ILLINOIS)	301432
METAL-GAS EQUILIBRIUM IN THE NI0BIUM-NITROGEN	301432
TERMINAL SOLID SOLUTION	301432
ACTA MET 11, 231 (1963)	301432
CA 58, 13207 (1963)	301432

COST, J WERT, C	300681
METAL-GAS EQUILIBRIUM AND THE NIOBIUM-NITROGEN	300681
SOLID SOLUTION	300681
CONTRACT AF49(638)672 (1962)	300681
AF OSR-2067	300681
COUGHLIN, J	700914
(BUR OF MINES BERKELEY CALIF)	700914
CONTRIBUTIONS TO THE DATA OF THEORETICAL METALLURGY XII HEATS	700914
AND FREE ENERGIES OF FORMATION OF INORGANIC OXIDES	700914
BUR MINES BUL 542 (1954)	700914
NSA 9, 529 (1955)	700914
COURTEL, R LORIER, J	400519
FORMATION OF CUBIC CE2O3 IN THE OXIDATION OF CERIUM AS	400519
EVIDENCED BY ELECTRON DIFFRACTION	400519
COMPT REND 230, 735 (1950)	400519
CA 44, 6326 (1950)	400519
COWGILL, M STRINGER, J	500122
(UNIV LIVERPOOL LIVERPOOL ENGLAND)	500122
EFFECT OF OXYGEN PRESSURE ON THE HIGH-TEMPERATURE OXIDATION	500122
OF TANTALUM	500122
J LESS-COMMON METALS 2, 233 (1960)	500122
CA 55, 14261 (1961)	500122
Cox, B CHADD, P SHORT, J	201963
(AT ENERGY RES ESTAB HARWELL ENGLAND)	201963
OXIDATION AND CORROSION OF ZIRCONIUM AND ITS ALLOYS. XV.	201963
FURTHER STUDIES OF ZIRCONIUM-NIOBIUM ALLOYS	201963
U K AT ENERGY AUTHORITY AERE-R 4134, (1962)	201963
CA 58, 316 (1963)	201963
CRANF, L	300811
EFFECT OF OXYGEN UPON THE HEAT CAPACITY OF GADOLINIUM	300811
BETWEEN 1.3 AND 5 DEGREES K	300811
J CHEM PHYS 36, 10 (1962)	300811
PA 65, NO 2053, (1962)	300811
CRANGLE, J SMITH, T	300869
SPECIFIC HEAT OF METALLIC PALLADIUM BETWEEN 65 AND	300869
105 DEGREES K	300869
PHYS REV LETTERS 9, NO 3, 86 (1962)	300869
CREMER, E FAESSLER, A KRAMER, H	201034
(UNIV INNSBRUCK INNSBRUCK AUSTRIA)	201034
PROOF OF THE EXISTENCE OF DISILICON TRIOXIDE (Si2O3)	201034
NATURWISSENSCHAFTEN 46, 377 (1959)	201034
CA 55, 14151 (1961)	201034
CRISP, R WILLIAMS, S	201000
(UNIV WESTERN PERTH AUSTRALIA)	201000
THE SOFT X-RAY SPECTRA OF LITHIUM, MAGNESIUM, AND ALUMINUM,	201000
AND THEIR ALLOYS	201000
PHIL MAG 5, 1205 (1960)	201000
CRONI, J ARMANTROUT, C KATØ, H	201972
(US BUR MINES ALBANY OREGON)	201972
TITANIUM-IRIDIUM PHASE DIAGRAM	201972
US BUR MINES REPT INVEST NO 6079, (1962)	201972
CA 58, 1191 (1963)	201972

CROMER, D	601062
(LOS ALAMOS SCI LAB	601062
LOS ALAMOS	601062
THE CRYSTAL STRUCTURE OF MONOCLINIC SM2O3	601062
J PHYS CHEM 61, 753 (1957)	601062
CA 51, 14363 (1957)	601062
NSA 11, 8863 (1957)	601062
CROWELL, A	300701
POTENTIAL ENERGY FUNCTIONS FOR GRAPHITE	300701
J CHEM PHYS 29, 446 (1962)	300701
CROXTON, F	900955
(UNION CARBIDE CCC	600955
OAK RIDGE	600955
TENN)	600955
URANIUM AND ITS COMPOUNDS BIBLIOGRAPHY OF UNCLASSIFIED	600955
LITERATURE	600955
USAEC K-295(Pt 2), 708 (1951)	600955
CA 48, 7443 (1954)	600955
NSA 5, 7056 (1951)	600955
CUBICCIOTTI, D	100194
THE REACTION BETWEEN U AND O	100194
J AM CHEM SOC 74, 1079 (1952)	100194
CA 47, 4175 (1953)	100194
CUNNINGHAM, B	601026
THERMODYNAMICS OF THE HEAVY ELEMENTS	601026
PROC INTERN CONF PEACEFUL USES ATOMIC ENERGY, GENEVA	601026
7, 225 (1956)	601026
CA 50, 15202 (1956)	601026
CUNNINGHAM, G W WARD, J J ALEXANDER, C A	301208
(BATTELLE MEMORIAL INST	301208
COLUMBUS	301208
OHIO)	301208
THERMODYNAMICS FOR COMPATIBILITY STUDIES OF METAL CLAD	301208
URANIUM CARBIDE	301208
PAPER 14-25-63 OF 65TH ANNUAL MEETING OF AM CERAMIC SOC	301208
PITTSBURGH, PA APRIL 30, 1963	301208
CERAMIC BULLETIN 42, 267 (1963)	301208
CURTIS, C	600903
BIBLIOGRAPHY OF HAFNIUM OXIDE, HAFNIUM SILICATE AND HAFNIUM	600903
CARBIDE	600903
ORNL-1321 (1952)	600903
CURTIS, C	700835
PROPERTIES OF YTTRIUM OXIDE CERAMICS	700835
J AM CERAM SOC 40, 274 (1957)	700835
CA 51, 17126 (1957)	700835
CURTIS, C DONEY, L JOHNSON, J	300867
SOME PROPERTIES OF HAFNIUM OXIDE, HAFNIUM SILICATE,	300867
CALCIUM HAFNATE, AND HAFNIUM CARBIDE	300867
J AM CERAMIC SOC 37, 458 (1954)	300867
CURTIS, C THARP, A	700804
CERAMIC PROPERTIES OF EUROPIUM OXIDE	700804
J AM CERAM SOC 42, 151 (1959)	700804
CA 53, 10690 (1959)	700804
CZARNY, Z	301209
(ZAKLADY CHEMICZNE	301209
OSWIECIM	301209
POLAND)	301209
STUDIES ON AMORPHOUS FORMS OF TA2O5	301209
CA 59, 2362E (1963)	301209

DAANE, A RUNDLE, R SMITH, H SPEDDING, F	601215
THE CRYSTAL STRUCTURE OF SAMARIUM	601215
ISC-404 (1953)	601215
NSA 7, 6113 (1953)	601215
DAANE, A RUNDLE, R SMITH, H SPEDDING, F	601230
THE CRYSTAL STRUCTURE OF SAMARIUM	601230
ACTA CRYST 7, 532 (1954)	601230
NSA 8, 6777 (1954)	601230
DACHILLE, F RØY, R	202022
A NEW HIGH-PRESSURE FORM OF TITANIUM OXIDE	202022
ABSTRACT FOR 64TH ANNUAL AM CERAMIC SOCIETY MEETING	202022
MAY 1, 1962 NEW YORK	202022
DACHILLE, F RØY, R	301210
HIGH PRESSURE REGION OF THE SILICA ISOTYPES	301210
Z KRIST 111, 451 (1959)	301210
CA 54, 12709B (1960)	301210
DADAPF, V MARGRAVE, J	300551
PROOF OF THE EXISTENCE OF Si2O3	300551
ANGEW CHEM 74, 83 (1962)	300551
BHT NO 2, 48 (1962)	300551
DAGERHAMN, T	300478
X-RAY STUDY ON SOLID SOLUTIONS OF OXYGEN IN HAFNIUM	300478
ACTA CHEM SCAND 15, 214 (1961)	300478
BHT NO 3, 6 (1961)	300478
DAHL, A CLEAVES, H	400580
THE FREEZING POINT OF URANIUM	400580
J. RES NAT BUREAU STDS 43, 513 (1949)	400580
CA 44, 3861 (1950)	400580
DAHL, A VANDUSEN, M	601644
RESISTANCE-TEMPERATURE RELATION AND THERMOELECTRIC	601644
PROPERTIES OF URANIUM	601644
J RES NAT BUR STDS 39, 53 (1947)	601644
DANCY, E EVERETT, L MCCABE, C	300876
STANDARD FREE ENERGY OF FORMATION OF CERIUM AND	300876
PRASEODYMIUM MONOCARBIDES	300876
TRANS MET SOC AIME 224, NO 6, 1095 (1962)	300876
DANFORTH, W	601317
(BARTOL RES FOUNDATION SWARTHMORE PA)	601317
ELECTRICAL PROPERTIES OF THORIUM OXIDE AND SIMILAR	601317
MATERIALS AT HIGH TEMP	601317
NP-6206 (1957)	601317
NSA 11, 4854 (1957)	601317
DANFORTH, W MORGAN, F	400535
ELECTRICAL RESISTANCE OF THORIA	400535
PHYS REV 79, 142 (1950)	400535
CA 44, 8188 (1950)	400535
DANILOVA, G KAMENSKAYA, Y MALTSEV, M	300206
MODIFICATIONS OF CARBIDE PHASES IN TITANIUM ALLOYS	300206
IZVEST AKAD NAUK SSSR, OTDEL TEKH, NAUK, 150 (1957)	300206
DAOU, J	600615

STUDY OF THE RESISTIVITY OF THE NITRIDES OF CERIUM AND PRASEODYMIUM	600615
COMPT REND 250, 3635 (1960)	600615
NS 14, 19596 (1960)	600615
DARNELL, A MCCOLLUM, W MILNE, T	700567
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	700567
VAPOR PRESSURE OF THORIUM	700567
J PHY CHEM 64, 341 (1960)	700567
NSA 14, 12568 (1960)	700567
DARNELL, A MCCOLLUM, W	201182
(ATOMICS INTERN CANOGA PARK CAL)	201182
HIGH TEMPERATURE REACTIONS OF THORIUM AND THORIA	201182
AND THE VAPOR PRESSURE OF THORIA	201182
US AT ENERGY COMM NAA-SR-6498 (1961)	201182
CA 56, 32 (1962)	201182
DARNELL, F MOORE, E	202023
(E I DU PONT DE NEMOURS + CO WILMINGTON DELAWARE)	202023
CRYSTAL STRUCTURE OF DYSPROSIUM AT LOW TEMPERATURES	202023
J APPL PHYS 34, 1337 (1963)	202023
CA 58, 9697 (1963)	202023
DARRAS, R	301433
COMPATIBILITY OF BERYLLIUM WITH CARBON DIOXIDE AT HIGH	301433
TEMPERATURES	301433
BULL INFORM SCI TECH (PARIS) NO 62, 43 (1962)	301433
CA 58, 7669 (1963)	301433
DARRAS, R PAIDASSI, J LEROY, F	201918
KINETICS OF OXIDATION OF MAGNESIUM IN OXYGEN, NITROGEN, AND	201918
SYNTHETIC AIR AT ELEVATED TEMPERATURES	201918
COMPT REND 255, 903 (1962)	201918
CA 57, 15857 (1962)	201918
DAS, C SAHOO, B PATNAIK, D	201466
(UTKAL UNIV CUTTACK INDIA)	201466
PREPARATION OF URANIUM DIOXIDE	201466
J SCI IND RESEARCH (INDIA) 20B, 505 (1961)	201466
CA 56, 11165 (1962)	201466
DASHKOVSKII, A SAVITSKII, E	201865
TEMPERATURE DEPENDENCE OF INTERNAL FRICTION, SHEAR, MODULUS,	201865
AND LINEAR EXPANSION OF LANTHANUM AND CERIUM	201865
MET I METALLOVED CHRISTYKH METAL SB NAUCHN RABOT 1961, NO 3,	201865
196 (1961)	201865
CA 57, 12225 (1962)	201865
DAVIS, S ANTHROP, D SEARCY, A	701009
(UNIV OF CALIFORNIA BERKELEY CAL)	701009
VAPOR PRESSURE OF SI AND DISSOCIATION PRESSURE OF SIC	701009
J CHEM PHYS 34, 659 (1961)	701009
NSA 15, 9468 (1961)	701009
DAUNT, J OLSEN, J	701027
(OHIO STATE UNIV COLUMBUS OHIO)	701027
COMPRESSIBILITY, ZERO-POINT ENERGY, AND SPECIFIC HEAT IN	701027
SUPERCONDUCTORS	701027
PHYS REV LETTERS 6, 267 (1961)	701027
NSA 15, 14784 (1961)	701027
DAVID, L	600957

THORIUM A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE	600957
USAEC-TID-3044, 124 (1953)	600957
CA 48, 6843 (1954)	600957
DAVIS, A	600880
HEAT OF SUBLIMATION AND VAPOR PRESSURE OF CARBON	600880
J ANOMALIES 1, 1 (1960)	600880
NS 15, 9461 (1961)	600880
DAVISON, A GIACCHETTI, A STANLEY, R	300823
(PURDUE UNIV LAFAYETTE IND)	300823
INTERFEROMETRIC WAVELENGTHS OF THORIUM LINES BETWEEN 2650	300823
AND 3400 ANGSTROMS	300823
J OPT SOC AM 52, 447 (1962)	300823
DAWSON, J	100187
ELECTRONIC STRUCTURE OF THE HEAVIEST ELEMENTS	100187
NUCLEONICS 10, 9, 39 (1952)	100187
CA 47, 7887 (1953)	100187
DAWSON, R BRACKETT, E BRACKETT, T	202024
(WILLIAM MARSH RICE UNIV HOUSTON TEXAS)	202024
A HIGH-TEMPERATURE CALORIMETER- THE ENTHALPIES OF	202024
ALPHA-ALUMINIUM OXIDE AND SODIUM CHLORIDE	202024
J PHYS CHEM 67 (8), 1669 (1963)	202024
CA 59, 7030 (1963)	202024
DAY, A SOSMAN, R	900137
NITROGEN THERMOMETER FROM ZINC TO PALLADIUM	900137
AM J SCI 29, 43 (1910)	900137
CA 4, 851 (1910)	900137
DAY, J FREYMAN, M FREYMAN, R	400517
ANOMALIES IN THE DIELECTRIC PROPERTIES OF THE OXIDE UO2	400517
COMPT REND 229, 1013 (1949)	400517
CA 44, 2301 (1950)	400517
DAYAL, R	300223
DERIVATION OF POTENTIAL ENERGY OF CRYSTALS FROM THERMODYNAMIC	300223
DATA	300223
PROC NATL INST SCI INDIA PT A 25, NO 4 206 (1959)	300223
CA 55, 13032 (1961)	300223
DAYTON, R	601509
(BATTELLE MEM INST COLUMBUS OHIO)	601509
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAR 1956	601509
BMI-1080 (1957)	601509
NSA 12, 890 (1958)	601509
DAYTON, R	601529
(BATTELLE MEM INST COLUMBUS OHIO)	601529
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCT 1958	601529
BMI-1301 (1958)	601529
NSA-13, 15343 (U959)	601529
DAYTON, R	601557
(BATTELLE MEM INST COLUMBUS OHIO)	601557
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY 1958	601557
BMI-1267 (1958)	601557
NSA 13, 2176 (1959)	601557
DAYTON, R	601556
(BATTELLE MEM INST COLUMBUS OHIO)	601556

PROGRESS RELATING TO CIVILIAN APPLICATIONS FOR SEPT 1958	601556
BMI-1294 (1958)	601556
NSA 13, 2177 (1959)	601556
DAYTON, R	601527
(BATTELLE MEM INST COLUMBUS OHIO)	601527
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING DEC 1958	601527
BMI-1307	601527
NSA 13, 16196 (1959)	601527
DAYTON, R	601526
(BATTELLE MEM INST COLUMBUS OHIO)	601526
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JAN 1958	601526
BMI-1315	601526
NSA 13, 16970 (1959)	601526
DEAR, P	201548
(BULL VA POLYTECH INST)	201548
SOLID STATE EQUILIBRIUMS FOR THE TERNARY SYSTEM STRONTIA-	201548
MAGNESIA-SILICA	201548
ENG EXPT STA SER NO 142, (1960)	201548
CA 56, 15017 (1962)	201548
DEBUIGNE, J LEHR, P	202025
(C N R S VITRY-SUR-SEINE FRANCE)	202025
DETERMINATION OF THE DIFFUSION COEFFICIENTS OF OXYGEN IN THE	202025
SYSTEM ZIRCONIUM-OXYGEN	202025
COMPT REND 256, 1113 (1963)	202025
CA 58, 9930 (1963)	202025
DEBUIGNE, J LEHR, P	201885
THE OXIDATION OF ZIRCONIUM	201885
COMPT REND 254, 3710 (1962)	201885
CA 57, 13396 (1962)	201885
DE COMBARIEU, A COSTA, P MICHEL, J	202021
(CENTRES ETUDES NUCL GENÈBLE FRANCE)	202021
THE SPECIFIC HEAT OF URANIUM MONOCARBIDE AT LOW	202021
TEMPERATURE	202021
COMPT REND 256 (26), 5518 (1963)	202021
CA 59, 8190 (1963)	202021
DEDUIT, J	700611
REDUCTION OF DIVANADIUM PENTOXIDE	700611
ANN CHIM (FRANCE) 6, 163 (1961)	700611
DEEV, V SMIRNOV, V	301108
SATURATED VAPOR PRESSURE OF RHENIUM DISULFIDE DIOXIDE AND	301108
TRIOXIDE	301108
DOK AKAD NAUK SSSR 140, NO 4 822 (1961)	301108
COTS 55, 259 (1962)	301108
DEEZSI, I	600737
THE GAMMA, EPSILON, AND DELTA (SPECTROSCOPIC) BANDS OF THE	600737
NITROGEN OXIDE MOLECULE	600737
MAG TUD AKAD KOZ FIZ KUT INT KOZ 4, 5 (1956)	600737
CA 53, 2773 (1959)	600737
DEEZSI, I	600738
A RECENT ROTATIONAL ANALYSIS OF THE ALPHA-BANDS OF THE NO	600738
MOLECULE	600738
ACTA PHYS ACAD SCI HUNG 9, 125 (1958)	600738
CA 53, 10945 (1959)	600738

DEEZSI, I MATRAI, T	600739
NEW BANDS OF THE NITROGEN MONOXIDE MOLECULE IN THE GAMMA,	600739
EPSILON, RHO BAND REGION	600739
M FIZ FOLYORAT 5, 201 (1957)	600739
CA 53, 5864 (1959)	600739
DEGTEVA, T	400594
THERMAL DEGRADATION OF FLUORINATED ELASTOMERS OF THE KEL-F AND	400594
PEP/VF TYPES	400594
VYSOK SOD 3, (1961)	400594
DEISS, W	300877
VACUUM VAPORIZATION OF URANIUM	300877
COMPT REND 256, 671 (1962)	300877
DEKHTYAR, I	300411
DETERMINATION OF THE EQUILIBRIUM CONCENTRATION OF VACANCIES	300411
AND THE ENERGY OF THEIR FORMATION IN METALS	300411
IZVEST VYSSHIKH UCHEB ZAVEDENII FIZ NO 1, 3 (1959)	300411
CA 55, 14041 (1961)	300411
DELBØVE, F	201107
DETERMINATION OF THE HEAT OF FUSION AND THE ENTROPY OF FUSION	201107
OF CALCIUM FLUORIDE BY THE CRYOMETRIC METHOD, AT HIGH TEMP-	201107
ERATURES (GREATER THAN 1400 DEGREES)	201107
COMPT REND 252, 2192 (1961)	201107
CA 55, 18276 (1961)	201107
DELIMARSKY, Y BUDFRASKAYA, G	300880
SOLUBILITY OF THE DIOXIDES OF TITANIUM, ZIRCONIUM, AND HAFNIUM	300880
IN FUSED FLUORIDES OF ALKALI METALS	300880
UKRAIN KHIM ZHUR 28, 565 (1962)	300880
DEMARIA, G GUIDØ, M MALASPINA	202097
ENTHALPY OF VAPORIZATION OF HOLMIUM	202097
ANN CHIM (ROME) 53, 1044 (1963)	202097
DEMARIA, G BURNS, R DRØWART, J INGRAM, M	601163
(U OF CHICAGO CHICAGO ILL)	601163
MASS-SPECTROMETRIC STUDY OF GASEOUS MOLYBDENUM,	601163
TUNGSTEN, AND URANIUM OXIDE	601163
J CHEM PHYS 32, 1373 (1960)	601163
CA 54, 23541 (1960)	601163
NSA 14, 16645 (1960)	601163
DEMPSEY, E	301134
(UNION CARBIDE RES INST TARRYTOWN NY)	301134
BONDING IN THE REFRACTORY HARD-METALS	301134
PHIL MAG 8, (86) 285 (1963)	301134
BHT NO 1, 15 (1963)	301134
DENCH, W A	301211
(NAT PHYS LAB TEDDINGTON MIDDLESEX ENGLAND)	301211
ADIABATIC HIGH-TEMPERATURE CALORIMETER FOR THE MEASUREMENT OF	301211
HEATS OF ALLØYING	301211
TRANS FARADAY SOC 59, (6), 1279 (1963)	301211
BHT NO 2 (1963)	301211
DENTREMØNT, J CHIPMAN, J	300841
THE FREE ENERGY OF SILICON CARBIDE FROM ITS SOLUBILITY IN	300841
MØLTEN SILVER	300841
J PHYSICAL CHEMISTRY 67, 499 (1963)	300841

DEODHAR, G PADALIA, B	300576
FORBIDDEN TRANSITIONS IN THE L-SPECTRUM OF IRIIDIUM	300576
NATURWISSENSCHAFTEN 49, NO 16, 373 (1962)	300576
DERGE, G MARTIN, A	201526
(UNIV OF CHICAGO CHICAGO ILL)	201526
BOMB REDUCTION OF URANIUM AND URANIUM ALLOYS	201526
US AT ENERGY COMM CT-2276, (1944)	201526
CA 56, 13907 (1962)	201526
DERGUNOVA, V KOLONIN, Y TSEITLIN, V	202026
CERMET ALLOYS OF THE SYSTEM ZIRCONIUM CARBIDE-TANTALUM	202026
CARBIDE	202026
TSVETN MET 36, 58 (1963)	202026
CT NO 17, 124 AUG 19, 1963	202026
DESCHANVRES, A	600848
THE RELATION IN THE SOLID STATE OF SEVERAL OXYGENATED	600848
COMPOUNDS OF RHENIUM	600848
ANN CHIM (PARIS) 4, 1217 (1959)	600848
CA 55, 20562 (1961)	600848
DEUTSCH, A	600982
(MT WILSON OBSERVATORY PASADENA CAL)	600982
THE SPECTRUM VARIABLES OF TYPE A	600982
PUBL ASTRON SOC PACIFIC 68, 92 (1956)	600982
CA 50, 9862 (1956)	600982
DEUTSCH, G AULT, G	301434
(NATL AERON + SPACE ADMIN WASHINGTON D C)	301434
POWDER METALLURGY MATERIALS FOR ROCKETS MISSILES AND SPACE	301434
VEHICLES	301434
PLANSEE PROC 4TH SEMINAR REUTTE/TYROL 1961, 723 (1962)	301434
CA 58, 2225 (1963)	301434
DEUTSCH, J MERRILL, P	202027
GROSS DIFFERENCES BETWEEN THE R CYGNI SPECTRA AT TWO	202027
SUCCESSIVE MAXIMA	202027
ASTROPHYS J 130, 570 (1959)	202027
CA 54, 1065 (1960)	202027
DEUTSCH, N ERVIN, G UELTZ, H	500123
ELECTROLYTIC PREPARATION OF THORIUM, URANIUM, NIOBIUM,	500123
TANTALUM, VANADIUM, TUNGSTEN, MOLYBDENUM AND CHROMIUM	500123
GER PATENT 1078776 (1960)	500123
CA 55, 18398 (1961)	500123
DE VRIES, K BAKER, G GIBBS, P	600665
A SURVEY OF HIGH PRESSURE EFFECTS OF SOLIDS	600665
WADC-TR-59-341 (1960)	600665
NS 15, 4388 (1961)	600665
DEWAR, J	700511
ATOMIC SPECIFIC HEATS BETWEEN THE BOILING POINTS OF LIQUID	700511
NITROGEN AND HYDROGEN, I. THE MEAN ATOMIC SPECIFIC HEATS AT	700511
50 DEGREES ABSOLUTE OF THE ELEMENTS AS A PERIODIC FUNCTION OF	700511
THE ATOMIC WEIGHT	700511
PROC ROY SOC A89, 158 (1913)	700511
CA 8, 457 (1914)	700511
DEWING, E	201204
(ALUMINUM LABS LTD ARVIDA CANADA)	201204

THE THERMODYNAMICS OF THE CONVERSION OF MAGNESIUM AND MANGANESE OXIDES TO SULFIDES J IRON STEEL INST (LONDON) 195, 56 (1960) CA 56, 245 (1962)	201204 201204 201204 201204
DEWOLFF, P (TECH HOGESCHOOL DELFT NETHERLANDS) ON THE UNIT CELL OF MALLINCRÖDTS UO3 ACTA CRYST 14, 322 (1961) NSA 15, 13381 (1961) CA 56, 6741 (1962)	601424 601424 601424 601424 601424 601424
DEYE, R PREPARATION OF PURE THORIUM ATOMIC ENERGY RES EST REPT NO AERE-C/R 425 (1949) NSA 4, 2627 (1950)	601156 601156 601156 601156
DE ZOUBOV, N POURBAIX, M ELECTROCHEMICAL BEHAVIOR OF RUTHENIUM POTENTIAL-PH DIAGRAM FOR THE RUTHENIUM WATER SYSTEM AT 25 DEGREES CEBELCOR(CENTRE BELGE ETUDE CORROSION) RAPPT TECH NO 58, 1 (1958) CA 52, 18012 (1958)	601076 601076 601076 601076 601076 601076
DIAMOND, J SCHNEIDER, S (NBS WASHINGTON D C) APPARENT TEMPERATURE MEASURED AT MELTING POINTS OF SOME METAL OXIDES IN A SOLAR FURNACE J AM CERAM SOC 43, 1 (1960) CA 54, 6240 (1960)	202028 202028 202028 202028 202028 202028
DIDCHENKO, R GORTSEMA, F (UNION CARBIDE CORP PARMA OHIO) ELECTRIC AND MAGNETIC PROPERTIES OF RARE EARTH MONOSULFIDES AND NITRIDES J PHYS CHEM SOLIDS 24 (7), 863 (1963) CA 58, 5918 (1963)	301435 301435 301435 301435 301435 301435
DIDENKO, V YARYSHEV, N METHOD FOR THE DETERMINATION OF HEAT CAPACITY AT HIGH TEMPERATURES ZAVODSK LAB 28, NO 7, 825 (1962)	300878 300878 300878 300878
DIDENKO, V YARYSHEV, N A TECHNIQUE OF THERMAL CAPACITY DETERMINATION AT HIGH TEMPERATURES IND LAB (USSR) 28, (7) 874 (1963) BHT NO 1, 3 (1963)	301135 301135 301135 301135 301135
DIEKE, G CROSSWHITE, H DUNN, B (JOHN HOPKINS UNIV SILVER SPRINGS MD) EMISSION SPECTRA OF THE DOUBLY AND TRIPLY IONIZED RARE EARTHS J OPT SOC AM 51, 820 (1961) NSA 15, 24872 (1961)	601406 601406 601406 601406 601406
DIEKE, G HEATH, D STRUCTURE OF THE INFRARED Y BANDS OF N2 J CHEM PHYS 33, 432 (1960) NS 14, 21446 (1960)	600618 600618 600618 600618
DIEKE, G SARUP, R (JOHNS HOPKINS UNIV BALTIMORE MD) FLUORESCENCE SPECTRUM AND THE ENERGY LEVELS OF THE SM++ ION	201718 201718 201718

J CHEM PHYS 36, 371 (1962)	201718
CA 57, 5426 (1962)	201718
DIETZE, H BALTSESEN, E	300242
DIFFUSION OF VACANCIES IN FE-SI UNDER IRRADIATION WITH FAST	300242
NEUTRONS	300242
NUKLEONIK 3, 93 (1961)	300242
CA 55, 21826 (1961)	300242
DIETZEL, A JAGODZINSKI, H SCHOLZE, H	700676
THERMODYNAMIC, X-RAY, INFRARED SPECTROSCOPIC, AND CHEMICAL	700676
INVESTIGATION OF TECHNICAL SILICON CARBIDE	700676
BER DEUT KERAM GES 37, 524 (1960)	700676
CERAM A 44, 166 (1961)	700677
DIRINGER, M	601353
(CNRS BELLEVUE FRANCE)	601353
ISOTOPIC DISPLACEMENTS IN THE SPECTRUM OF URANIUM	601353
COMPT REND 250, 828 (1960)	601353
NSA 14, 9857 (1960)	601353
DIXON, J LAGRANGE, L MERTEN, U MILLER, C PORTER II, J	301436
(GENERAL DYNAMICS CORP SAN DIEGO CALIF)	301436
ELECTRICAL RESISTIVITY OF STABILIZED ZIRCONIA AT ELEVATED	301436
TEMPERATURES	301436
J ELECTROCHEM SOC 110, 276 (1963)	301436
CA 58, 10818 (1963)	301436
DÖBRÖLEZH, S A ZUBKOVA, S M KRAVETS, V A	301437
(GOS TEKHNI IZD KIEV SSSR)	301437
SILICON CARBIDE	301437
KIEV GOS TEKHNI IZD UKR SSR (1963)	301437
CA 59, 6110D (1963)	301437
DÖERNENBURG, E HINTENBERGER, H FRANZEN, J	700664
STRUCTURE OF POLYATOMIC CARBON MOLECULE FORMED IN HIGH-	700664
FREQUENCY SPARKS	700664
Z NATURFORSCH 16A, 532 (1961)	700664
CT NO 15, (1961)	700664
DÖLLOFF, R	700989
RESEARCH STUDY TO DETERMINE THE PHASE EQUILIBRIUM RELATIONS	700989
OF SELECTED METAL CARBIDES AT HIGH TEMPERATURES	700989
WADD-TR-60-143 (1960)	700989
NSA 15, 4304 (1961)	700989
DÖMAGALA, R	300302
A STUDY OF THE TI-ZR02 SYSTEM	300302
AD 249532 DIV 17 10 PAGES	300302
DÖNÖHUE, J	201351
(UNIV S CALIF LOS ANGELES CALIF)	201351
STRUCTURE OF URANIUM IN THIN FILM	201351
ACTA CRYST 14, 327 (1961)	201351
CA 56, 6737 (1962)	201351
DÖNTSÖV, Y	601055
ISOTOPIC SHIFT IN THE SPECTRUM OF DYSPROSIUM	601055
OPTIKA I SPEKTRÖSKÖPIYA 1, 612 (1956)	601055
CA 51, 11059 (1957)	601055
DÖRNENBURG, E HINTERBERGER, H FRANZEN, J	300467
STRUCTURE OF POLYATOMIC CARBON MOLECULES IN HIGH-FREQUENCY	300467

DISCHARGES	
Z NATURFÖRSCH 16, 532 (1961)	300467
BHTG NØ 4, 10 (1962)	300467
DØUGLAS, A	600576
THE NEAR ULTRAVIOLET BANDS OF N2+AND THE DISSOCIATION	600576
ENERGIES OF THE N2+AND N2 MOLECULES	600576
CAN J PHYS 30, 302 (1952)	600576
CA 46, 9980 (1952)	600576
DØUGLAS, A	600678
RECENT SPECTROSCOPIC STUDIES OF SIMPLE MOLECULES	600678
J PHYS CHEM 59, 109 (1955)	600678
CA 49, 5103 (1955)	600678
DØUGLAS, A HERZBERG, G	600577
PREDISSOCIATION AND DISSOCIATION OF THE NITROGEN MOLECULE	600577
CAN J PHYS 29, 294 (1951)	600577
CA 45, 8884 (1951)	600577
DØUGLAS, A MØLLER, C	600708
PREDISSOCIATION OF THE C120 AND C130 MOLECULES	600708
CAN J PHYSICS 33, 125 (1955)	600708
CA 49, 6725 (1955)	600708
DØUGLAS, A RØUTLY, P	600679
SPECTRUM OF THE CN MOLECULE	600679
ASTROPHYS J 1, 295 (1955)	600679
CA 49, 7379 (1955)	600679
DØUGLAS, A RØUTLY, P	600682
THE SPECTRA OF CN+ AND CN MOLECULES	600682
ASTROPHYS J 117, 461 (1953)	600682
CA 47, 7317 (1953)	600682
DØUGLAS, D KUNZ, F	300419
CØLUMBIA METALLURGY	300419
VØL 10 OF METALLURGICAL SOCIETY CONFERENCES INTERSCIENCE (1961)	300419
DØUGLAS, T	202029
HIGH TEMPERATURE THERMODYNAMIC FUNCTIONS FOR ZIRCONIUM AND	202029
UNSATURATED ZIRCONIUM HYDRIDES	202029
J RES NATL BUR STD 67A, 403 (1963)	202029
DØUGLASS, R	601010
(U OF CALIFØRNIA LOS ALAMOS NM)	601010
NEODYMIUM SESQUIOXIDE, ND2O3, FORM A	601010
ANAL CHEM 28, 551 (1956)	601010
CA 50, 7538 (1956)	601010
DØUGLASS, R ADKINS, E	700614
(BATTELLE MEMØRIAL INST CØLUMBUS OHIO)	700614
A STUDY OF THE SPECTRAL EMISSIVITIES AND MELTING	700614
TEMPERATURES OF ØSMIUM AND RUTHENIUM	700614
TRANS MET SOC OF AIME 221, 248 (1961)	700614
NSA 15, 17358 (1961)	700614
DØUGLASS, D ST PIERRE, G SPEISER, R	201341
(OHIO STATE UNIV CØLUMBUS OHIO)	201341
THE KINETICS AND MECHANISM OF THE CONVERSION OF TITANIUM	201341
OXIDES TO TITANIUM NITRIDE	201341
MET SOC CONF 8, 705 (1961)	201341
CA 56, 5738 (1962)	201341

DOUGLASS, R HOLDEN, F JAFFEE, R	700375
HIGH TEMPERATURE PROPERTIES AND ALLLOYING BEHAVIOR OF THE	700375
REFRACTORY PLATINUM-GROUP METALS	700375
PR 161823 (1959)	700375
BAT TECH REV 9, 12, 18 (1960)	700375
DOUGLASS, R STARITZKY, E	601011
SAMARIUM SESQUIOXIDE, SM ₂ O ₃ , FORM B	601011
ANAL CHEM 28, 552 (1956)	601011
CA 50, 7538 (1956)	601011
DRAGSDØRE, R FØRGENG, W	201712
(KANSAS STATE UNIV MANHATTAN KANSAS)	201712
THE INTERMETALLIC PHASES IN THE COBALT-TANTALUM SYSTEM	201712
ACTA CRYST 15, 531 (1962)	201712
CA 57, 5389 (1962)	201712
DRAPER, A MILLIGAN, W	201104
(RICE INST HOUSTON TEXAS)	201104
STRUCTURE AND SURFACE CHEMISTRY OF THORIUM OXIDE	201104
US AT ENERGY COMM AECU-4395 (1959)	201104
CA 55, 18248 (1961)	201104
DREGER, L	300720
VAPOR-PRESSURE MEASUREMENTS WITH A MAGNETICALLY CONTROLLED	300720
BALANCE PART 1. BOAT AND CHAIR LACTONES PART 2. ALN, BN, AND	300720
TIN. PART 3. PT, PD, RH, AND IR.	300720
DISS ABS 22, 3423 (1962)	300720
DREGER, L	300528
VAPOR PRESSURE MEASUREMENTS WITH A MAGNETICALLY-CONTROLLED	300528
BALANCE II ALN, BN, AND TIN III PT, PD, RH AND IR	300528
DISS ABSTR 22, NO 10, 3423 (1961)	300528
BHT NO 2, 25 (1962)	300528
DREGER, L DADAPE, V MARGRAVE, J	300604
SUBLIMATION AND DECOMPOSITION STUDIES ON BORON NITRIDE	300604
AND ALUMINUM NITRIDE	300604
J PHYS CHEM 66, 1556 (1962)	300604
DREGER, L DADAPE, V MARGRAVE, J	600642
PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. SUBLIMATION	600642
AND DECOMPOSITION STUDIES ON BORON NITRIDE AND ALUMINUM	600642
NITRIDE	600642
TID-6512 (1960)	600642
NS 15, 3092 (1961)	600642
DREGER, L MARGRAVE, J	700991
(UNIV OF WISCONSIN WISCONSIN)	700991
THE HIGH-TEMPERATURE DECOMPOSITION OF TIN	700991
TID-6512 (1960)	700991
NSA 15, 3093 (1961)	700991
DREGER, L MARGRAVE, J	200922
(UNIV OF WISCONSIN MADISON WISCONSIN)	200922
VAPOR PRESSURE OF PLATINUM METALS I PALLADIUM AND PLATINUM	200922
J PHYS CHEM 64, 1323 (1960)	200922
CA 55, 7953 (1961)	200922
DREGER, L MARGRAVE, J	201500
(UNIV WISCONSIN MADISON WISCONSIN)	201500
VAPOR PRESSURE OF PLATINUM METALS. II. RHODIUM	201500

J PHYS CHEM 65, 2106 (1961)	201500
CA 56, 13560 (1962)	201500
DREGER, L MARGRAVE, J	600643
PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. VAPOR PRESSURES	600643
OF PLATINUM METALS. II. RHODIUM AND IRIDIUM	600643
TID-6512 (1960)	600643
NS 15, 3091 (1961)	600643
DREISBACH, R	300263
(DOW CHEMICAL CO MIDLAND MICH)	300263
PHYSICAL PROPERTIES OF CHEMICAL COMPOUNDS	300263
ADVANCES IN CHEM SER NO 29, 489 (1961)	300263
DRESSLER, K	600578
ABSORPTION SPECTRUM OF VIBRATIONALLY EXCITED N2 IN ACTIVE	600578
NITROGEN	600578
J CHEM PHYS 30, 1621 (1959)	600578
CA 53, 19562 (1959)	600578
DREYFUS, B	201220
(UNIV GRENØBLE GRENØBLE FRANCE)	201220
THE SPECIFIC HEAT OF DYSPROSIUM FROM 0.5 TO 4 DEGREES K	201220
COMPT REND 253, 1085 (1961)	201220
CA 56, 1009 (1962)	201220
DREYFUS, B GOODMAN, B LACAZE, A TRØLLIET, G	300646
THE SPECIFIC HEATS OF SOME RARE EARTH METALS BETWEEN 0.5	300646
AND 4 DEGREES K	300646
COMPT REND 253, 1764 (1961)	300646
CA 56, 4166 (1962)	300646
PA 65, 2051 (1962)	300646
DREYFUS, B GOODMAN, B TRØLLIET, G WEIL, I	601417
THE SPECIFIC HEAT OF THE HYPERFINE STRUCTURE OF SAMARIUM	601417
COMPT REND 251, 1743 (1961)	601417
NSA 15, 16215 (1961)	601417
DRØEGE, J	201160
(BATTELLE MEM INST COLUMBUS OHIO)	201160
METHOD FOR MEASUREMENT OF THE HEAT OF FORMATION	201160
OF SILICON CARBIDE	201160
US DEPT COMM OFFICE TECH SERV PB REPT 148094 (1960)	201160
CA 55, 21775 (1961)	201160
DRØWART, J DEMARIA, G	200770
THERMODYNAMIC STUDY OF THE BINARY SYSTEM CARBON-SILICON, USING	200770
THE MASS SPECTROMETER	200770
SILICON CARBIDE, PROC CONF, BOSTON 1959, 16 (1961)	200770
CA 55, 7015 (1961)	200770
DRØWART, J DE MARIA, G BØERBØOM, J H INGRAM, M G	301212
MASS SPECTROMETRIC STUDY OF INTER-GROUP IV B MOLECULES	301212
J CHEM PHYS 30, 308 (1959)	301212
DRØWART, J GØLDFINGER, P	201917
(UNIV LIBRE BRUSSELS BELGIUM)	201917
HIGH TEMPERATURE CHEMISTRY	201917
ANN REV PHYS CHEM 13, 459 (1962)	201917
CA 57, 15811 (1962)	201917
DRØZIN, N	300534
CALCULATION OF HIGH TEMPERATURE ENTROPIES OF CRYSTALLINE	300534

COMPOUNDS	300534
ZH FIZ KHIM 35, 2472 (1961)	300534
BHT NO 2, 29 (1962)	300534
CCP NO 4, 290 (1962)	300534
CA 56, 9512 (1962)	300534
DRÖZIN, N	300668
(RES INST FUNDAMENTAL CHEM KHARKOV POLAND)	300668
APPLICATION OF BERTHELOT'S PRINCIPLE IN CALCULATING	300668
STANDARD ENTROPIES OF INORGANIC SOLIDS	300668
ZHUR FIZ KHIM 35, 1789 (1961)	300668
CA 56, 76 (1962)	300668
DRUDING, L	200962
(IOWA ST UNIV SCI AND TECH AMES IOWA)	200962
INTERACTIONS OF PRASEODYMIUM AND NEODYMIUM METALS WITH THEIR	200962
MOLTEN CHLORIDES AND IODIDES	200962
UNIV MICROFILMS (ANN ARBOR MICH) LC CARD NO MIC 60-4892	200962
DISSERTATION ABSTR 21, 1751 (1961)	200962
CA 55, 11157 (1961)	200962
DRUDING, L CORBETT, J	201166
(IOWA STATE UNIV AMES IOWA)	201166
LOWER OXIDATION STATES OF THE LANTHANIDES, NEODYMIUM (II)	201166
CHLORIDE AND IODIDE	201166
J AM CHEM SOC 83, 2462 (1961)	201166
CA 55, 21943 (1961)	201166
DUAN, F NAY-BEN, M CHI, L TIAN-NAN, L	301213
EXPERIMENTAL EVIDENCE FOR THE EXISTENCE OF DISLOCATIONS WITH	301213
BURGERS VECTOR (100) IN MOLYBDENUM CRYSTALS	301213
SCIENTIA SINICA 12, 979 (1963)	301213
DUHART, P	300875
THE BORIDES OF MAGNESIUM AND ALUMINUM	300875
ANN CHIM (PARIS) 7, 339 (1962)	300875
CA 58, 213 (1963)	300875
DUNN, H	601024
(OAK RIDGE NAT LAB OAK RIDGE TENN)	601024
X-RAY DIFFRACTION DATA FOR URANIUM COMPOUNDS	601024
U S ATOMIC ENERGY COMM ORNL-2092, 45 (1956)	601024
CA 50, 15167 (1956)	601024
DUPOUY, J AVERBACH, B	201180
(MIT CAMBRIDGE MASS)	201180
ATOMIC ARRANGEMENTS IN TI-MO SOLID SOLUTIONS	201180
ACTA MET 9, 765 (1961)	201180
CA 55, 23276 (1961)	201180
DURAKOV, V BATSANOV, S	300753
DETERMINATION OF THE IONIC PARTS OF BONDS IN MOLECULES	300753
AND RADICALS II	300753
ZH STRUKT KHIM 2, 456 (1961)	300753
CA 57, 4051 (1962)	300753
DURIG, J LORD, R GARDNER, W JOHNSTON, L	201969
(MIT CAMBRIDGE MASS)	201969
INFRARED TRANSMITTANCE AND REFLECTANCE OF BERYLLIUM OXIDE	201969
J OPT SOC AM 52, 1078 (1962)	201969
CA 58, 1068 (1963)	201969
DWIGHT, A	201200

ARGONNE NATL LAB	LEMONT	ILL)	201200
SOME AB3 COMPOUNDS OF THE TRANSITION METALS			201200
ACTA CRYST 14, 75 (1961)			201200
CA 56, 87 (1962)			201200
EAKINS, J D HUMPHRIES, D G			301214
(AT ENERGY RES ESTAB	HARWELL	ENGLAND)	301214
PREPARATION OF TECHNETIUM METAL			301214
J INORG NUCL CHEM 25, 737 (1963)			301214
CA 59, 1335C (1963)			301214
ECKSTEIN, B FORMAN, R			300805
PREPARATION AND SOME PROPERTIES OF TANTALUM CARBIDE			300805
J APPL PHYS 33, 82 (1962)			300805
PA 65, 2448 (1962)			300805
EDING, H CARR, E			201061
HIGH-PURITY URANIUM COMPOUNDS			201061
US AT ENERGY COMM ANL 6339 (1961)			201061
CA 55, 16243 (1961)			201061
EDELEANU, C LITTLEWOOD, R			200838
(HINXTON HALL	CAMBRIDGE	ENGLAND)	200838
THERMODYNAMICS OF CORROSION IN FUSED CHLORIDES			200838
ELECTROCHIM ACTA 3, 195 (1960)			200838
CA 55, 3184 (1961)			200838
EDWARDS, A			200948
(AUSTRALIAN DEFENSE SCI SERV MELBOURNE		AUSTRALIA)	200948
PROPOSED TRANSFORMATIONS IN PURE CHROMIUM			200948
J AUSTRALIAN INST METALS 5, 182 (1960)			200948
CA 55, 10249 (1961)			200948
EDWARDS, J KINGTON, G			300623
LOW TEMPERATURE ADIABATIC CALORIMETER AND THE HEAT CAPACITY			300623
OF ALPHA-ALUMINA			300623
TRANS. FAR. SOC. 58, 1313 (1962)			300623
EDWARDS, P HAPPEL, R			301136
(US NAVAL ORDNANCE LAB	SILVER SPRINGS	MD)	301136
BERYLLIUM OXIDE WHISKERS AND PLATELETS			301136
J APPL PHYS 33, 943 (1962)			301136
BHT NO 7, 3 (1963)			301136
EDWARDS, J SPEISER, R JOHNSTON, H			601179
HIGH TEMPERATURE STRUCTURE AND THERMAL EXPANSION OF SOME			601179
METALS AS DETERMINED BY X-RAY DIFFRACTION DATA I PLATINUM,			601179
TANTALUM, NIObIUM AND MOLYBDENUM			601179
J APPL PHYS 22, 424 (1951)			601179
NSA 5, 3431 (1951)			601179
EDWARDS, R			601235
STUDIES OF MATERIALS AT HIGH TEMPERATURE			601235
AECD-3394 UCRL-1639 (1952)			601235
NSA 6, 4074 (1952)			601235
EDWARDS, R RAINE, T			300288
THE SOLID SOLUBILITIES OF SOME STABLE CARBIDES IN COBALT			300288
NICKEL AND IRON AT 1250 DEG C			300288
PLANSEE PROCEEDING 232 (1952)			300288
EDWARDS, S			301438

(UNIV OF MANCHESTER	MANCHESTER	ENGLAND)	301438
THE ELECTRONIC STRUCTURE OF LIQUID METALS			301438
PROC ROY SOC (LONDON) SER A 267, 518 (1962)			301438
CA 58, 3907 (1963)			301438
EFREMØV, N			600932
A NEW METHOD OF CALCULATION OF EFFECTIVE IONIC RADII OF LANTHANIDES			600932
PHYS REV 93, 934 (1954)			600932
CA 49, 10042 (1955)			600932
EGYED, L			700739
COMPRESSIBILITY OF THE ELEMENTS			700739
ACTA GEOL ACAD SCI HUNG 2, 205 (1954)			700739
CA 48, 13294 (1954)			700739
EHL, R			201141
(UNIV OF WISCONSIN	MADISON	WISCONSIN)	201141
BINARY NITROGEN COMPOUNDS OF THE ELEMENTS, A LITERATURE SURVEY			201141
US DEPT COM OFFICE TECH SERV PB REPT 161315 (1959)			201141
CA 55, 20741 (1961)			201141
EHRENSTEIN, D	HEIDELBERG, G	KÖPFERMANN, H	PENSELIN, S
INVESTIGATION OF THE HYPERFINE STRUCTURE SPLITTING OF THE TWO GROUND STATES 2D3/2 AND 2D5/2 OF YTTRIUM-89 BY USING ATOMIC BEAM RESONANCE METHODS			
NATURWISSENSCHAFTEN 44, 255 (1957)			
CA 51, 15265 (1957)			
EHRLICH, P	GUTSCHE, W	SEIFERT, H	
(UNIV GISSEN		GERMANY)	
PREPARATION AND CRYSTAL STRUCTURE OF TITANIUM DIBROMIDE			
Z ANORG U ALLGEM CHEM 312, 80 (1961)			
CA 56, 5617 (1962)			
EICHELBERGER, J			601420
(MOUND LAB	MIAMISBURG	OHIO)	601420
MOUND LABORATORY MONTHLY PROGRESS			601420
REPORTS FOR FEB AND MARCH 1961			601420
MLM-1112 AND MLM 1113			601420
NSA 15, 17880, 17881 (1961)			601420
EICK, H			301439
(MICHIGAN STATE UNIV	EAST LANSING	MICHIGAN)	301439
RARE EARTH BORIDES AND NITRIDES			301439
RARE EARTH RES SEMINAR LAKE ARROWHEAD CALIF			301439
1960, 297 (1961)			301439
CA 58, 12275 (1963)			301439
EICK, H			601537
(KANSAS UNIV	LAWRENCE	KANSAS)	601537
PRECISE LATTICE PARAMETERS OF SELECTED RARE EARTH			601537
TETRA AND HEXABORIDES			601537
AECU-4087 (1958)			601537
NSA 13, 10826 (1959)			601537
EICK, H			601053
(STATE UNIV OF IOWA	IOWA CITY	IOWA)	601053
NITRIDES AND LOWER OXIDES OF SAMARIUM, EUROPIUM, AND YTTERBIUM			601053
UNIV MICROFILMS (ANN ARBOR MICH) PUBL NO 17470			601053
CA 51, 9247 (1957)			601053
EICK, H			601289

ISTATE UNIV OF IOWA	IOWA CITY	IOWA)	601247
LOWER OXIDES OF SM AND EU THE PREPARATION AND CRYSTAL			601289
STRUCTURE OF $SmO_{0.4-0.6}$, SmO , EuO			601289
J AM CHEM SOC 78, 5147 (1956)			601289
NSA 11, 130 (1957)			601289
EICK, H. BAENZIGER, N. EYRING, L.			601046
(STATE UNIV IOWA	IOWA CITY	IOWA)	601046
THE PREPARATION, CRYSTAL STRUCTURE, AND SOME PROPERTIES			601046
OF SmN , EuN , YbN			601046
J AM CHEM SOC 78, 5987 (1956)			601046
CA 51, 5611 (1957)			601046
EICK, H. GILLES, P.			601184
(UNIV OF KANSAS	LAWRENCE	KANSAS)	601184
PRECISE LATTICE PARAMETERS OF SELECTED RARE EARTH TETRA AND			601184
HEXAFORIDES			601184
J AM CHEM SOC 81, 5030 (1959)			601184
CA 54, 12713 (1960)			601184
EICK, H. RAUH, E. THORN, R.			601614
VAPORIZATION STUDIES OF THE URANIUM DICARBIDE PHASE			601614
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,			601614
PROC. VIENNA, MAY 1962			601614
NSA 16, 25393 (1962)			601614
EISENBERG, Y.			400577
THE EVEN CONFIGURATIONS $D_3 + D_2^2 + D_2^2$ OF TH II			400577
PHYSICA 18, 177 (1952)			400577
CA 46, 4359 (1952)			400577
EISENSTEIN, J.			201030
(NATL BUR OF STANDARDS	WASHINGTON	D C)	201030
SPECTRUM OF REF 6			201030
J CHEM PHYS 33, 1530 (1960)			201030
CA 55, 14058 (1961)			201030
EISENSTEIN, J.			201126
(NATL BUR STANDARDS	WASH	DC)	201126
ABSORPTION SPECTRUM AND MAGNETIC PROPERTIES			201126
OF OSMIUM HEXAFLUORIDE			201126
J CHEM PHYS 34, 310 (1961)			201126
CA 55, 19470 (1961)			201126
ELESTRØM, M.			300367
THE CRYSTAL STRUCTURE OF Cr_3B_4			300367
ACTA CHEM SCAND 15, 1178 (1961)			300367
CA 56, 8106 (1962)			300367
ELIASHBERG, G.			300881
LOW TEMPERATURE HEAT CAPACITY OF METALS			300881
ZHUR TEKHN EKSPERIM FIZ 43, 1105 (1962)			300881
ELLE, M. CHIPMAN, J.			300281
THE COLUMBIUM-OXYGEN EQUILIBRIUM IN LIQUID IRON			300281
TRANS AIME 221, 701 (1961)			300281
ELLINGER, F.			600977
(U. OF CALIFORNIA	LOS ALAMOS	N.M.)	600977
CRYSTAL STRUCTURE OF NEODYMIUM METAL			600977
J MET 7 AIME TRANS 203, 411 (1955)			600977
CA 49, 5239 (1955)			600977

ELLINGER, F			601253
THE CRYSTAL STRUCTURE OF NEODYMIUM METAL AND NEODYMIUM			601253
MONOXIDE			601253
AECU-2593 LADC 1460 (1953)			601253
NSA 7, 4968 (1953)			601253
ELLINGER, F ZACHARIASEN, W			600947
(LOS ALAMOS SCI LAB	LOS ALAMOS	N.M.)	600947
CRYSTAL STRUCTURES OF SAMARIUM METAL AND OF SAMARIUM			600947
MONOXIDE			600947
J AM CHEM SOC 75, 5650 (1953)			600947
CA 48, 13332 (1954)			600947
ELLIOTT, G LEMONS, J			301440
(LOS ALAMOS SCI LAB	LOS ALAMOS	NEW MEXICO)	301440
NONSTOICHIOMETRY IN INTERMETALLIC COMPOUNDS			301440
ADVAN CHEM SER 39, 144 (1963)			301440
CA 58, 13225 (1963)			301440
ELLIOTT, R			301441
(ILLINOIS INST OF TECHNOL	CHICAGO	ILLINOIS)	301441
THE METALLOGRAPHY OF NIOBIUM-OXYGEN AND NIOBIUM			301441
CARBON ALLOYS			301441
US AT ENERGY COMM TID-7625, 8 (1962)			301441
CA 58, 12246 (1963)			301441
ELLIOTT, R			300262
(ILL INST OF TECH	CHICAGO	ILL)	300262
NIOBIUM-CARBON SYSTEM			300262
TRANS AM SOC METALS 53, 13 (1961)			300262
CA 55, 20874 (1961)			300262
NSA 15, 3142 (1961)			300262
ELLIOTT, R			600625
COLUMBIUM OXYGEN SYSTEM			600625
TRANS AM SOC METALS 52, 990 (1960)			600625
NS 14, 22079 (1960)			600625
ELLIOTT, R			700718
(ILLINOIS INST OF TECH	CHICAGO	ILL)	700718
THE BORON-CARBON SYSTEM			700718
ARF-2200-9 (1961)			700718
NSA 15, 11572 (1961)			700718
ELLIOTT, R KOMJATHY, S			701063
(ILLINOIS INST OF TECH	CHICAGO	ILL)	701063
COLUMBIUM-NITROGEN SYSTEM			701063
COLUMBIUM METALLURGY P 367 INTERSCIENCE PUBLISHERS NY (1961)			701063
NSA 15, 32464 (1961)			701063
ELLIOTT, R KOMJATHY, S			600621
NIOBIUM PHASE DIAGRAMS			600621
ARF 2120 (1960)			600621
NS 14, 22003 (1960)			600621
ELLIOTT, R VAN THYNE, R			600622
THE BORON CARBON SYSTEM			600622
ARF 2200-3 (1960)			600622
NS 14, 22004 (1960)			600622
ELLIOTT, R VAN THYNE, R			701069
(ILLINOIS INST OF TECH	CHICAGO	ILLINOIS)	701069
THE BORON - CARBON SYSTEM			701069

QUARTERLY REPORT NO 2 FOR AUG 1, 1960- OCT 31, 1960	APF-2200-6	701069
NSA 15, 6373 (1961)		701069
ELLIS, R		200980
(RAYTHEON CO	WALTHAM	MASS)
VARIOUS PREPARATIONS OF ELEMENTAL BORON		200980
BORON SYNTHESIS STRUCTURE PROPERTIES PROC CONF ASBURY PARK		200980
N.J. 1959, 42 (1960)		200980
CA 55, 12125 (1961)		200980
ELYASHEVICH, M		601413
SPECTRA OF THE RARE EARTHS		601413
AEC-TR-4403		601413
SPEKTRY REDKIKI ZEMEL, STATE PUB HOUSE OF		601413
TECH LIT, MOSCOW, (1953)		601413
NSA 15, 19889 (1961)		601413
ELYASHEVICH, M NIKITINA, O		301090
TRIPLET QUINTET TRANSITIONS IN THE ATOMIC SPECTUM		301090
OF SILICON		301090
SOVIET PHYSICS DOKLADY 1, (1956)		301090
DOKLADY AKAD NAUK SSSR 111, 325 (1956)		301090
CA 52, 7847 (1958)		301090
EMEL'YANOV, V EVSTYUKHIN, A LEONTEV, G		201088
IODIDE NIOBIUM AND SOME OF ITS PROPERTIES		201088
MET I METALLOVED CHISTYKH METAL SBORNIK NAUCH-RABOT 1960,		201088
NO 2, 27 (1960)		201088
CA 55, 17419 (1961)		201088
EMLEY, E		100209
THE FREE ENERGIES OF FORMATION OF THE FLUORIDES, CHLORIDES AND		100209
OXIDES OF ALKALI, ALKALINE EARTH, AND RARE EARTH METALS, AND		100209
THE OCCURENCE IN FUSED SALT MIXTURES OF DOUBLE-DECOMPOSITION		100209
REACTIONS INVOLVING THESE SUBSTANCES		100209
CHEM ENG SCI 1, 131 (1952)		100209
CA 47, 1481 (1953)		100209
EMONS, H BOENICKE, H		300562
PREPARATION OF SILICON MONOXIDE FROM SILICON AND		300562
DIFFERENT MODIFICATIONS OF SILICON DIOXIDE		300562
J PRAKT CHEM 18, NO 1, 11 (1962)		300562
EMRICH, B R		301182
(A S D WPAB	OHIO)	301182
LITERATURE SURVEY OF SYNTHESIS PROPERTIES AND APPLICATIONS OF		301182
SELECTED BORIDE COMPOUNDS		301182
ASD TDR 62-873 AD295 467		301182
TAB 63-2-3 10 (1963)		301182
ENCE, E MARGOLIN, H		200919
(NEW YORK UNIV	NY	NY)
Ti-2R SYSTEM		200919
TRANS AIME 221, 205 (1961)		200919
CA 55, 7248 (1961)		200919
ENCE, E MARGOLIN, H		300162
TITANIUM-ZIRCONIUM SYSTEM		300162
TRANS MET SOC AIME 215, 205 (1961)		300162
ENIG, J		202030
A COMPLETE E.P.V.T.S. THERMODYNAMIC DESCRIPTION OF		202030
METALS BASED ON THE P M MIRROR-IMAGE APPROXIMATION		202030

J APPLIED PHYS 34, 746 APRIL (1963)	202030
ENGELKE, J HALDEN, F FARLEY, E	201529
SYNTHESIS OF NEW HIGH TEMPERATURE MATERIALS	201529
U S DEPT COM OFFICE TECH SERV P B REPT 161, (1960)	201529
CA 56, 13909 (1962)	201529
ENGLE, G GØEDDEL, W LUBY, C	201525
(GEN DYNAMICS CORP SAN DIEGO CAL)	201525
REACTION RATE STUDIES OF THORIUM-URANIUM DICARBIDES IN	201525
MOIST AIR	201525
J AM CERAM SOC 45, 136 (1962)	201525
CA 56, 13826 (1962)	201525
EPELBAUM, V SEVASTYANOV, N GUREVICH, M ØRMONT, B ZHDANOV, G	700931
PHASES FORMED IN THE CHROMIUM-BORON SYSTEM	700931
ZHUR NEORG KHIM 2, 1848 (1957)	700931
AEC-TR-4058	700931
NSA 15, 14753 (1961)	700931
EPELBAUM, V SEVASTYANOV, N GUREVICH, M ZHDANOV, G	600800
PHASES FORMED IN THE BORON-RICH REGION OF THE CR-BORON SYSTEM	600800
ZHUR STRUKT KHIM 1, NO 1, 64 (1960)	600800
CA 55, 16066 (1961)	600800
NS 15, 11690 (1961)	600800
EPELBAUM, V SEVASTYANOV, N ØRMONT, B GUREVICH, M	300202
POSSIBILITY OF EXISTENCE OF BODY-CENTERED PHASES OF BORON	300202
CARBIDE AND SILICON OXYCARBIDE	300202
ZHUR STRUKT KHIM 2, 65 (1961)	300202
CHEM TITLE NO 13 107 (1961)	300202
EPELBAUM, V STAROSTINA, M	300194
THERMOCHEMICAL INVESTIGATIONS OF BORON AND CERTAIN BORIDES	300194
BOR, TUDY KONF KHIM BORA I EGØ SØEDINII, 97 (1955)	300194
CA 54, 23701 (1960)	300194
EPPRECHT, W	301109
CRYSTAL CHEMISTRY OF METAL CARBIDES AND THEIR IMPORTANCE	301109
IN METALLURGY	301109
CHIMIA 5, 49 (1959)	301109
COTS 54, 123 (1962)	301109
EPREMIEN, E	601515
(DIV RESEARCH AEC OAK RIDGE TENN)	601515
URANIUM ALLØY NEWSLETTER NO 14	601515
WASH-296 (1957)	601515
NSA 12, 7209 (1958)	601515
ERBEN, E LESSER, R	300323
TANTALUM	300323
METALL 15, 679 (1961)	300323
EREMENKO, V	300286
TITANIUM AND ITS ALLOYS	300286
IZDATEL AKAD NAUK UKR SSR 1960, 500 (1960)	300286
CA 54, 17220 (1960)	300286
EREMENKO, V KOSOLAPOVA, T	300212
THE INTERACTION OF TIC WITH NI	300212
VØPRØSY PØRØSHKØVØI MET I PØCHNØSTI MATERIALØV AKAD NAUK UKR	300212
SSR NO 7, 3 (1959)	300212
CA 55, 18498 (1961)	300212

EREMENKO, V LESNIK, N	300285
THE REACTION OF TIC WITH COBALT	300285
VOPROSY POROSHKOVOI MET I PROCHNOSTI MATERIALOV AKAD NAUK	300285
UKR SSR 3, 73 (1956)	300285
CA 51, 7273 (1957)	300285
EREMENKO, V NAIDICH, Y	300529
SURFACE TENSION OF MOLTEN RH AND PD	300529
IZV AKAD NAUK SSSR OTD TEKH NAUK MET I TOPLIVO, NO 6, 100	300529
(1962)	300529
BHT NO 2, 26 (1962)	300529
EREMENKO, V NIZHENKO, V NAIDICH, V	300537
SURFACE TENSION OF SOME MOLTEN METALS	300537
IZV AKAD NAUK SSSR OTD TEKH NAUK MET I TOPLIVO NO 3, 150	300537
(1961)	300537
BHT NO 2, 34 (1962)	300537
CA 56, 7020 (1962)	300537
EREMENKO, V VELIKANOVA, T	201279
PREPARATION OF ALLOYS OF TITANIUM CARBIDE AND MOLYBDENUM	201279
METALLOKERAM MATERIALY I METODY IKH ISSLEDOVANIYA, AKAD,	201279
NAUK, UKR, SSR, INFORM MATERIALY 1959, 25	201279
CA 56, 3227 (1962)	201279
EREMENKO, V NIZHENKO, V TAI, S	200821
SURFACE TENSION OF LIQUID BERYLLIUM	200821
IZVEST AKAD NAUK SSSR, OTDEL TEKH NAUK,	200821
MET I TOPLIVO 1960, NO 3, 116 (1960)	200821
CA 55, 2406 (1961)	200821
EREMENKO, V TRETYACHENKO, L GOLUBENKO, Z	201711
THE ALPHA PHASE EXISTENCE LIMITS IN THE TANTALUM VANADIUM	201711
SYSTEMS	201711
POPOVIDI AKAD NAUK UKR RSR 1962, 192	201711
CA 57, 5384 (1962)	201711
EREMENKO, V TRETYACHENKO, L YAKHIMOVICH, R	201492
FUSION DIAGRAM OF THE TANTALUM VANADIUM SYSTEM	201492
ZH NEORGAN KHIM 5, 2290 (1960)	201492
CA 56, 12624 (1962)	201492
EREMENKO, V VELIKANOVA, T	201278
TRIANGULATION OF THE TITANIUM-CARBON-MOLYBDENUM SYSTEM	201278
POROSHKOVAYA MET, AKAD NAUK UKR SSR 1, NO 3, 20 (1961)	201278
CA 56, 3226 (1962)	201278
ERIKSEN, V HALG, W	600934
(BROWN BOVERI CO LTD BADEN SWITZERLAND)	600934
THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF	600934
URANIUM	600934
J NUCLEAR ENERGY 1, 232 (1955)	600934
CA 49, 12944 (1955)	600934
ERMANIS, F FARRER, P	201240
(NEW YORK UNIV NEW YORK NY)	201240
A REINVESTIGATION OF THE SYSTEMS TI-CR AND TI-V	201240
TRANS AIME 221, 904 (1961)	201240
CA 56, 1260 (1962)	201240
EROFEEVA, M LUKINYKH, N ARIYA, S	700602
HEAT CONTENTS OF SOME TITANIUM OXIDES AT HIGH TEMPERATURES	700602

ZHUR FIZ KHIM 35, 772 (1961)	700602
ESIN, O SRYVALIN, I	300276
THERMODYNAMIC PROPERTIES OF METALLIC ALLOYS AND THE PHASE	300276
DIAGRAMS	300276
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK NET I TOPLIVO	300276
N0 6, 116 (1960)	300276
CA 55, 12019 (1961)	300276
ESTULIN, G BUROVA, N	300552
THE OXIDATION OF Nb ALLOYS	300552
FIZ METAL I METALLOVED 12, 703 (1961)	300552
BHT N0 2, 48 (1961)	300552
ESTULIN, G EGORSHINA, T BUROVA, N	900207
PHASE COMPOSITION OF THE OXIDES OF ALLOYS ON THE BASES	900207
OF NIOBIUM	900207
FIZ METAL I METALLOV 13, N0 4, 550 (1962)	900207
FTD-TT-62-1297	900207
EULER, R WESTRUM, E	201157
(UNIV OF MICH ANN ARBOR MICH)	201157
HEAT CAPACITY AND THERMODYNAMIC PROPERTIES OF TITANIUM	201157
TETRAFLUORIDE FROM 6 TO 304 DEGREES K	201157
J PHYS CHEM 65, 132 (1961)	201157
CA 55, 21775 (1961)	201157
EVANS, D	201254
(UNIV BIRMINGHAM BIRMINGHAM ENGLAND)	201254
THE SOLUBILITY OF Zr IN ALPHA-THORIUM	201254
J NUCLEAR MATERIALS 4, 66 (1961)	201254
CA 56, 2054 (1962)	201254
EVANS, D RAYNOR, G	200874
LATTICE SPACINGS IN THORIUM-YTTRIUM ALLOYS	200874
J NUCLEAR MATERIALS 2, 209 (1960)	200874
CA 55, 5302 (1961)	200874
EVANS, P	601463
THE STRUCTURE OF U ₂ N ₃	601463
J AM CERAM SOC 45, 305 (1962)	601463
NSA 16, 20396 (1962)	601463
EVANS, P	201362
(UNIV MANCHESTER ENGLAND)	201362
SYSTEM UO ₂ -ZrO ₂	201362
J AM CERAM SOC 44, 631 (1961)	201362
CA 56, 6919 (1962)	201362
EVANS, D RAYNOR, G	201812
(UNIV BIRMINGHAM BIRMINGHAM ENGLAND)	201812
LATTICE-SPACING RELATIONSHIPS IN THE SYSTEM THORIUM-CERIUM-	201812
LANTHANUM	201812
J NUCL MATER 5, 308 (1962)	201812
CA 57, 9545 (1962)	201812
EVANS, P WILDSMITH, G	600768
EVIDENCE OF PHASE CHANGES IN ZIRCONIA FROM THERMAL ETCHING	600768
NATURE 189, 569 (1961)	600768
CA 55, 11991 (1961)	600768
EVDOKIMOVA, V VERESHCHAGIN, L	201072
DETERMINATION OF THE DISTANCE BETWEEN ATOMS IN SUBSTANCE UNDER	201072

PRESSURE. I. COMPRESSIBILITY OF BARIUM AND STRONTIUM FIZ TVERDØGØ TELA 2, 1701 (1960) CA 55, 17132 (1961)	201072 201072 201072
EVERHART, J LINDLIEF, W KANEGES, J MECHANICAL PROPERTIES OF METALS AND ALLOYS NBS-C-447, 481 (1943)	600907 600907 600907
EVSTYUKHIN, A THERMAL REDUCTION OF BEF ₂ BY MAGNESIUM MET I METALLØVED CHISTYKH METAL, SBØRNIK NAUCH RABØT 1959, NØ 1, 91 (1959) CA 55, 4292 (1961)	200852 200852 200852 200852 200852
EVSTYUKHIN, A BARINØV, I APPARATUS FOR MEASURING VAPOR PRESSURES OF ZIRCONIUM AND HAFNIUM CHLORIDES AND IODIDES MET I METALLØVED CHISTYKH METAL MØSKØV INZHENER FIZ INST SBØRNIK NAUD RABØT 1960, NØ 2, 49 (1960) BHTG NØ 2, 8 (1961)	300882 300882 300882 300882 300882 300882
EVSTYUKHIN, A NIKISHANOV, V MILØV, I ZONE REFINING OF NIOBIUM BY ELECTRIC ARC METHOD ISSLED PØ ZHARØPRØCH SPLAVAM AKAD NAUK SSSR INST MET 9, 218 (1962) CA 58, 7671B (1963)	301442 301442 301442 301442 301442
EVSTYUKHIN, A NIKISHANOV, V MILØV, I DISTRIBUTION OF CARBON AND TUNGSTEN IN COLUMBIUM DURING ITS ZONE REFINING IZV A N SSSR ØTN MET I TØP NØ 3, 98 (1962) ENG TRANS RUSS MET AND FUELS NØ 3, 82 (1962)	300883 300883 300883 300883 300883
EWING, C WALKER JR, B SPANN, J STEINKULLER, E MILLER, R (U S NAVAL RES LAB WASHINGTON D C) THERMAL CONDUCTIVITY OF REFRACTORY METALS J CHEM ENG DATA 7, 251 (1962) CA 57, 7922 (1962)	201768 201768 201768 201768 201768
EWING, R (GEN ELEC CO RICHLAND WASH) ABSORPTION SPECTRA OF SOLID UCL ₄ , UOCL ₂ J INØRG AND NUCLEAR CHEM 17, 177 (1961) CA 55, 19470 (1961)	201127 201127 201127 201127 201127
EYRING, L BAENZIGER, N ON THE STRUCTURE AND RELATED PROPERTIES OF THE OXIDES OF PRASEODYMIUM J APPL PHYS 33, 428 (1962) PA 65, 4418 (1962)	300825 300825 300825 300825 300825
EYRING, L SCHULDT, H VØRRES, K PHASE EQUILIBRIA KINETIC AND THERMODYNAMIC STUDIES OF SOME RARE EARTH AND OTHER METAL OXIDE AND NITRIDE SYSTEMS TID-5914 (1959) NS 14, 15629 (1960)	600634 600634 600634 600634 600634
EYRING, L HØLMBERG, B HYDE, B KAKØRØPØLØUS, P FELMLEE, T THE SOLID STATE CHEMISTRY OF RARE EARTH OXIDES TID-16350 (1962) NSA 16, 25323 (1962)	601590 601590 601590 601590
EYRING, L VØRRES, K SCHULDT, H	700748

PHASE EQUILIBRIA, KINETIC AND THERMODYNAMIC STUDIES OF SOME RARE EARTH METAL OXIDE AND NITRIDE SYSTEMS TECH PROG REP, TID-5956 (1960) NUCL SCI ABST 14, 15997 (1960)	700748 700748 700748 700748
FAETH, P A (PURDUE UNIV LAFAYETTE IND) HYSTERESIS EFFECTS AND THE STOICHIOMETRY OF PRASEODYMIUM OXIDE (1961) THESIS DISS ABST 22, NO 7 (1962) NSA 17, 177 (1963)	701076 701076 701076 701076 701076 701076
FAIRBROTHER, F COWLEY, A SCOTT, N THE OXYTRICHLORIDES AND OXYTRIBROMIDES OF NIOBIUM (COLUMBIUM) (V) AND TANTALUM (V) J LESS COMMON METALS 1, 206 (1959) CA 55, 6228 (1961)	200886 200886 200886 200886 200886
FANG, F KUZNETSOV, A KELER, E PHASE RELATIONS IN Y2O3-ZR02 SYSTEM IZV AKAD NAUK SSR, OTD KHIM NAUK 1141 (1962) CA 58, 2889B (1963)	301443 301443 301443 301443
FARBER, M ROCKET POWER PASADENA CALIF) HEAT OF FORMATION AND ENTROPY OF THE TRIMER OF BORON OXYFLUORIDE J CHEM PHYS 36, 661 (1962) CA 56, 13627 (1962)	201510 201510 201510 201510 201510 201510
FARBER, M DARNELL, A DISSOCIATION OF HYDROGEN AND NITROGEN ON TUNGSTEN FILAMENTS J CHEM PHYS 21, 172 (1953) CA 47, 8440 (1953)	600579 600579 600579 600579
FARIS, F (NORTH AM AVIATION INC DOWNEY CAL) RADIATION EFFECTS QUARTERLY PROGRESS REPT FOR OCT-DEC 1954 DECL MAR 1, 1957 NAA-SR-1286 NSA 11, 7889 (1957)	601310 601310 601310 601310 601310 601310
FARR, J HUBER, E HEAD, E HOLLEY, C THE PREPARATION OF URANIUM MONOCARBIDE AND ITS HEAT OF FORMATION J PHYS CHEM 63, 1455 (1959) CA 54, 5312 (1960)	601200 601200 601200 601200 601200
FASOLINO, L G (NAT RESEARCH CORP CAMBRIDGE MASS) THERMODYNAMIC PROPERTIES OF BIMETALLIC COMPOUNDS QUARTERLY LETTER REPORT JAN-MARCH (1963) AD, 335650	301215 301215 301215 301215 301215
FAUSTOVA, D IPPOLITOVA, E SPITSYN, V TRUE HEAT CAPACITY OF URANATES OF ALKALI ELEMENTS AND OF CALCIUM ISSLED V OBL KHIM URANA SB STATEI 1961, 148 CA 57, 2929 (1962)	201613 201613 201613 201613 201613
FEAST, M THE SCHUMANN RUNGE OXYGEN BANDS EMITTED AT ATMOSPHERIC	600553 600553

PRESSURE	600553
PRØC PHYS SØC (LØNDØN) 62A, 114 (1949)	600553
CA 44, 429 (1950)	600553
FEAST, M	600554
THE SCHUMANN RUNGE ØXYGEN EMISSION BANDS IN THE REGION	600554
3100-2500A	600554
PRØC PHYS SØC LØNDØN 63, 549 (1950)	600554
CA 45, 444 (1951)	600554
FEATHERSTØN, F NEIGHBOURS, J	301444
(US NAVAL POST-GRADUATE MONTEREY CALIF)	301444
ELASTIC CØNSTANTS ØF TANTALUM, TUNGSTEN, AND MØLYBDENUM	301444
PHYS REV 130, 1324 (1963)	301444
CA 58, 13154 (1963)	301444
FEAST, M	600580
ROTATIONAL ANALYSIS ØF THE (1,0) BAND ØF THE NITRØGEN FIRST	600580
POSITIVE SYSTEM	600580
PRØC PHYS SØC (LØNDØN) 63A, 568 (1950)	600580
CA 45, 444 (1951)	600580
FEAST, M	600740
TWO NEW 2SIGMA-2SIGMA SYSTEMS DUE TØ THE MOLECULE NØ	600740
CAN J RES 28A, 488 (1950)	600740
CA 45, 2774 (1951)	600740
FEBER, R	301445
US ATØMIC ENERGY CØMM LA 2841 (1963)	301445
HEATS ØF DISSØCIATION ØF GASEØUS CHLØRIDES.	301445
CA 59, 5859 (1963)	301445
FEDØRØV, G	600823
DETERMINATION ØF HEAT ØF SUBLIMATION ØF SILVER NICKEL AND	600823
ZIRCØNIUM BY THE METHOD ØF RADIOACTIVE INDICATORS	600823
MET I METALL CHISTYKH METAL SBØRNIK NAUCH	600823
RABØT NØ 2, 141 (1960)	600823
CA 55, 18491 (1961)	600823
FEDØRØV, G SMIRNØV, E	601620
THERMØDYNAMIC PROPERTIES ØF ZIRCØNIUM AND ITS ALLØYS WITH TIN	601620
IAEA SYMPOSIUM ØN THE THERMØDYNAMICS ØF NUCLEAR MATERIALS.	601620
PRØC, VIENNA, MAY 1962	601620
NSA 16, 25406 (1962)	601620
FEDØRØV, G SMIRNØV, E	601659
MEASUREMENT ØF PARTIAL PRESSURES ØF ZIRCØNIUM VAPØRS	601659
IN ITS ALLØYS WITH TIN. THERMØDYNAMIC CHARACTERISTICS	601659
ØF ZIRCØNIUM AND ITS ALLØYS	601659
MET I METALLØVED CHISTYKH METAL, SB NAUCHN RABØT 34, (1961)	601659
BHT (GASES) NØ 6 (1962)	601659
FEDØRØV, T SHAMRAI, F NISELSØN, L PETRUSEVICH, I	300197
PREPARATION ØF ELEMENTAL BØRØN	300197
ZHUR NEØRG KHIM 5, 226 (1960)	300197
FEDØSEEV, I NEMKØVA, Ø	201757
ØXIDATION ØF TITANIUM NITRIDE IN DRY AND MØIST AIR	201757
ZH NEØRGAN KHIM 7, 980 (1962)	201757
CA 57, 6849 (1962)	201757
FEIGELSEN, R	301446
(WATERTØWN ARSENAL WATERTØWN MASSI)	301446

SOME PHYSICAL PROPERTIES OF POLYCRYSTALLINE SILICON BORIDE AD277686 MAY 1962	301446 301446
FELDMAN, M (DUPONT AIKEN SC)	701045 701045
X-RAY DIFFRACTION STUDIES ON ZR AND ZIRCALØY-2. A LITERATURE SEARCH -	701045 701045
DP-551 (1961)	701045
NSA 15, 23939 (1961)	701045
FELTEN, E AITKEN, E	201690
(GEN ELEC CO CINCINNATI OHIO)	201690
MECHANISM AND KINETICS OF THE FORMATION OF VØ2.90-6YØ1.5	201690
J INØRG NUCL CHEM 24, 35 (1962)	201690
CA 57, 4286 (1962)	201690
FELTEN, E BENDER, I PØST, B	700857
EUROPIUM HEXABØRIDE AND LANTHANUM TETRABØRIDE	700857
J AM CHEM SØC 80, 3479 (1958)	700857
CA 53, 2912 (1959)	700857
FENG, C	201618
(RAYTHEON CO NEWTON MASS)	201618
ANGLE BETWEEN SOME LOW INDEX PLANES IN RHENIUM LATTICE	201618
J LESS COMMON METALS 4, 103 (1962)	201618
CA 57, 2946 (1962)	201618
FENG, C LEVESQUE, P	300530
THE FORMATION OF SIGMA PHASES AND ITS EFFECT ON THE	300530
WORKABILITY OF MO-RE ALLOYS	300530
TRANS AIME 221, NØ 6, 1278 (1961)	300530
BHT NØ 2, 26 (1962)	300530
FEØFILØV, P KAPLYANSKI, A	201755
SPECTRA OF BIVALENT RARE EARTH IONS IN THE CRYSTALS OF	201755
ALKALINE EARTH FLUØRIDES. I SAMARIUM	201755
ØPTIKA I SPEKTRØSKØPIYA 12, 493 (1962)	201755
CA 57, 6753 (1962)	201755
FERGUSSON, J RØBINSON, B RØPER, W	201686
(UNIV CANTERBURY NZ)	201686
IØDIDES OF ØSMIUM AND RHENIUM	201686
J CHEM SØC 1962, 2113	201686
CA 57, 4774 (1962)	201686
FERRARØ, J	700571
INØRGANIC INFRARED SPECTRØSCOPY	700571
J CHEM EDUC 38, 201 (1961)	700571
FERRIER, A	300791
CALCULATION OF THE HEAT OF FUSION OF IRØN FROM THE PHASE	300791
DIAGRAMS OF VARIOUS BINARY SYSTEMS	300791
C.R. ACAD SCI (FRANCE) 254, NØ 1, 104 (1962)	300791
PA 65, 7479 (1962)	300791
FERRISS, D RØSE, R WULFF, J	301137
(MASS INST TECH CAMBRIDGE MASS)	301137
DEFORMATION OF TA SINGLE CRYSTALS	301137
TRANS AIME 224, 5 975 (1962)	301137
BHT NØ 1, P 8, (1963)	301137
FERRØ, R RAMBALDI, G	201696
(UNIV GENØA ITALY)	201696

PHASE DIAG TYPE IN THE TH-RH ALLOY SYSTEM	201696
ACTA CRYST 14, 1094 (1961)	201696
CA 57, 4431 (1962)	201696
FERRI, R RAMBALDI, G CAPELLI, R	201626
(UNIV GENOA ITALY)	201626
THE ALLOYS OF NOBLE METALS WITH THE MORE ELECTROPOSITIVE	201626
ELEMENTS V MICROGRAPHIC AND X-RAY EXAMINATION OF SOME	201626
MAGNESIUM IRIDIUM ALLOYS	201626
J LESS COMMON METALS 4, 16 (1962)	201626
CA 57, 3145 (1962)	201626
FERT, A	301447
(CENTRE ETUDES NOCL SACLAY FRANCE)	301447
STRUCTURE OF SOME RARE EARTHS	301447
BULL SOC FRANC MINERAL CRIST 85, NO 3, 267 (1962)	301447
CA58, 3973 (1963)	301447
FESENKO, V	300711
THERMODYNAMIC PROPERTIES AND CHARACTERISTICS OF BORON	300711
NITRIDE AT HIGH TEMPERATURES	300711
POROSHKOVAYA MET. AKAD NAUK UKR SSR 1, NO 4, 80 (1961)	300711
CA 56, 10997 (1962)	300711
FESENKO, V V BOLGAR, A S	301216
EVAPORATION RATE AND VAPOR PRESSURE OF CARBIDES SILICIDES	301216
NITRIDES AND BORIDES	301216
POROSHKOVAYA MET AKAD NAUK UKR SSR 3, NO 1, 17 (1963)	301216
CA 59, 4560H (1963)	301216
FEILD, A AMMON, R LEWIS, A RICHARDSON, L	201950
(WESTINGHOUSE RES LAB PITTSBURGH PA)	201950
TANTALUM AND TUNGSTEN BASE ALLOYS	201950
U S DEPT COM OFFICE TECH SERV AD 259,116, (1961)	201950
CA 57, 16273 (1962)	201950
FEUER, P	202031
(PURDUE UNIV LAFAYETTE INDIANA)	202031
THE THERMAL ACCOMMODATION COEFFICIENTS OF A DIATOMIC GAS	202031
J CHEM PHYS 39 (5), 1311 (1963)	202031
CA 59, 7007 (1963)	202031
FIELDHOUSE, I LANG, J	601583
(ILLINOIS INST OF TECH CHICAGO ILL)	601583
MEASUREMENT OF THERMAL PROPERTIES	601583
WADD-TR-60-904 (1960)	601583
NSA 16, 4551 (1962)	601583
FINCH, R	700547
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	700547
MEASUREMENT OF RESISTIVITY AND HEAT CAPACITY OF METALLIC	700547
CONDUCTORS	700547
NAA-SR-MEMO 5819	700547
NSA 15, 9019 (1961)	700547
FIRSOVA, L	300697
DETERMINATION OF THE CONDENSATION COEFFICIENT FROM THE	300697
RATE OF SATURATION OF A CONFINED SPACE OR THE SPACE	300697
OF AN EFFUSION CHAMBER	300697
ZHUR FIZ KHIM 36, NO 6, 1332 (1962)	300697
FIRSOVA, L	301448
ON THE KINETICS OF EQUILIBRIUM OF VAPOR PRESSURE IN	301448

CONFINED SPACES AND IN THE SPACE OF EFFUSION CHAMBERS ZHUR FIZ KHIM 36, 2224 (1962)	301448 301448
FIRSØVA, L NESMEYANØV, A DEGRFE OF DISSOCIATION AND PARTIAL VAPØR PRESSURE OF THE OXIDES OF LITHIUM, BERYLLIUM, BØRØN, SILICØN AND LEAD ZHUR FIZ KHIM 34, 2615 (1960) CA 55, 6086 (1961)	200761 200761 200761 200761 200761
FIRSØVA, L NESMEYANØV, A (M V LØMØNØSØV STATE UNIV MØSCØW RUSSIA) DETERMINATION OF THE CONDENSATION COEFFICIENTS OF LITHIUM, BERYLLIUM, BØRØN, SILICØN, AND LEAD OXIDES ZHUR FIZ KHIM 34, 2719 (1960) CA 55, 13968 (1961)	201020 201020 201020 201020 201020 201020
FISCHER, W BRUNGER, K GRIENEISEN, H ØN METALLIC SCANDIUM Z ANØRG CHEM 231, 54 (1937)	700765 700765 700765
FISCHER-HJALMARS, I FLØDMARK, COVALENT BØRØN-BØRØN BØNDS IN CRYSTALS OF CERTAIN METAL BORIDES J CHEM PHYS 22, 1950 (1954) CA 49, 2239 (1955)	700821 700821 700821 700821 700821
FISHBURN JR, H DILL, W IDENTIFICATIONS OF MIXED PHASES OF MNØ2 PRØC ANN PØWER SØURCES CØNF 15, 98 (1961) CA 56, 6870 (1962)	201360 201360 201360 201360
FISHER, E MCSKIMIN, H (ARGØNNE NATL LAB LEMØNT ILL) LØW TEMPERATURE PHASE TRANSITION IN ALPHA-URANIUM PHYS ØEV 124, 67 (1961) NSA 15, 32578 (1961)	601455 601455 601455 601455 601455
FISHER, F CONSTRUCTION AND ØPERATION OF A HIGH-TEMPERATURE SØLAR FURNACE, STUDIES OF ELEMENTAL BØRØN UNIV MICROFILMS (ANN ARBØR, MICH) L C CARD NØ MIC 60-3336, DISSERTATION ABSTR 21, 826 (1960) CA 55, 6064 (1961)	200877 200877 200877 200877 200877 200877
FISHER, E (ARGØNNE NATL LAB LEMØNT ILL) LØW TEMPERATURE PHASE TRANSITION IN ALPHA-URANIUM PHYS ØEV 124, 67 (1961) CA 56, 2962 (1962)	201270 201270 201270 201270 201270
FISHTINE, S RELIABLE LATENT HEATS OF VAPØRIZATION IND ØNG CHEM 55, 20 (1963)	202032 202032 202032
FITZGERALD, L M HARDNESS AT HIGH TEMPERATURES OF SOME REFRACTØRY CARBIDES AND BORIDES J LESS-CØMMØN METALS 5, 356 (1963)	301217 301217 301217 301217
FIZZØTTI, C SARACERØ, F METALLURGICAL EXAMINATION OF URANIUM-RICH TERNARY ALLOYS CONTAINING MØLYBDENUM AND CARBØN CØMIT NAZL ENERGIA NUCL CHEN-113, (1962)	201697 201697 201697 201697

CA 57, 4431 (1962)	201697
FLAHAUT, J DÖMANGE, L KAMSUKØM, J	300512
A NEW TYPE OF CHEMICAL COMPOUND THE METALLIC SULFØBØRIDES	300512
CØMPT REND 254, 299 (1962)	300512
BHT NØ 2, 5 (1962)	300512
FLETCHER, G	300325
ANHARMØNICITY AND THE THERMAL EXPANSION OF SØLIDS	300325
AUSTRALIAN J PHYS 14, 420 (1961)	300325
BHT 4, 8 (1961)	300325
FLETCHER, W BEGUN, G	600763
FUNDAMENTAL OF N15Ø	600763
J CHEM PHYS 27, 579 (1957)	600763
CA 52, 878 (1958)	600763
FLINN, P A MARADUDIN, A A	301218
ANHARMØNIC CØNTRIBUTIØNS TØ VIBRATIØNAL THERMØDYNAMIC	301218
PROPERTIES OF SØLIDS. THE LØW TEMPERATURE LIMIT	301218
ANN PHYS (N Y) 22, NØ 2, 223 (1963)	301218
FLINTA, J	601095
IA B ATØMENERGI STØCKHØLM SWEDEN)	601095
THERMAL CØDUCTIVITY OF URANIUM DIOXIDE	601095
US ATØMIC ENERGY CØMM TID-7546, 516 (1958)	601095
CA 52, 9905 (1958)	601095
FLØDMARK, S	301033
(UNIV STØCKHØLM STØCKHØLM SWEDEN)	301033
THERØETICAL INVESTIGATIØN OF THE ELECTRØNIC ENERGY BANDS	301033
FØR THE ZIRCØNIUM-OXYGEN CRYSTAL	301033
U S DEPT CØM OFFICE TECH SERV AD 257 435. (1961)	301033
CA 58, 5128 (1963)	301033
FLØDMARK, S RØØS, B	301219
(UNIV STØCKHØLM STØCKHØLM SWEDEN)	301219
A LIGAND-FIELD INVESTIGATIØN OF ZR-O SYSTEM	301219
ACTA CHEM SCAND 17 (3), 859 (1963)	301219
CA 59, 4773F (1963)	301219
FLØERKE, Ø	301449
(TECHN EIDGEN HØCHSCH ZURICH SWITZERLAND)	301449
AMØRPHØUS AND MICRØCRYSTALLINE SIØ2	301449
CHEM ERDE 22, 91 (1962)	301449
CA58, 12031B (1963)	301449
FLØERKE Ø W	301220
A DISCUSSION OF THE TRIDYMITTE CRISTØBALITE PRØBLEM	301220
SILICATES INDS 26, 415 (1961)	301220
CA 56, 6732 E (1962)	301220
FLØTØW, H LØHR, H	601334
(ARGØNNE NATL LAB LEMØNT ILL)	601334
THE HEAT CAPACITY AND THERMØDYNAMIC	601334
FUNCTIONS OF URANIUM FRØM 5 TØ 350 DEGREES	601334
J PHYS CHEM 64, 904 (1960)	601334
NSA 14, 18932 (1960)	601334
FLUBACHER, P LEADBETTER, A MØRRISØN, J	300391
THE HEAT CAPACITY OF PURE SILICØN AND GERMANIUM AND PROPERTIES	300391
OF THEIR VIBRATIØNAL FREQUENCY SPECTRA	300391
PHIL MAG 4, NØ 8 273 (1959)	300391

CA 56, 13628 (1962)	300391
FØEX, M	201153
(SOLAR ENERGY LAB MONTLOUIS FRANCE	201153
THE PROPERTIES OF SOME SOLUTIONS AND COMPOUNDS	201153
WITH LANTHANUM OXIDE BASE	201153
BULL SOC CHIM, FRANCE 1961, 109 (1961)	201153
CA 55, 21737 (1961)	201153
FØGARASSY, B NEMETH, G	200879
A NEW POTENTIAL FUNCTION FOR DIATOMIC MOLECULES	200879
ACTA PHYS ACAD SCI HUNG 11, 265 (1960)	200879
CA 55, 6072 (1961)	200879
FØMENKØ, V	201420
THERMOEMISSIVE PROPERTIES OF HAFNIUM AND NIØBIUM CARBIDES AND	201420
SCANDIUM AND THULIUM BORIDES	201420
RADIOTEKH I ELEKTRØN 6, 1406 (1961)	201420
CA 56, 9560 (1962)	201420
FØMICHEV, E KANDYBA, V KANTØR, P	300885
CALORIMETRIC INSTALLATION FOR THE DETERMINATION OF THE	300885
ENTHALPY AND HEAT CAPACITY OF MATERIALS	300885
IZMERITELN TEKHN 1962, NØ 5, 15 (1962)	300885
CA 57, 15889 (1962)	300885
FØRELIK, C YELUTIN, V	300884
RØENTGENOGRAPHIC INVESTIGATION OF THE RECRYSTALLIZATION	300884
PROCESS OF THE BORIDES OF TITANIUM, ZIRCØNIUM AND MØLYBDENUM,	300884
AND THE CARBIDES OF TITANIUM AND TUNGSTEN	300884
IZ VYSSHIKH UCHEB ZAVED, TSVET METAL NØ 4, 143 (1962)	300884
JPRS-16059	300884
CØTS NØ 59, 157 (1962)	300884
FØREMAN, A	301083
ANHARMØNIC SPECIFIC HEAT OF SOLIDS	301083
PRØC PHYS SOC 79, 1624 (1962)	301083
FØRNEY, G MARSHAL, J	300238
(ELECTROTHERMAL INDUST INC PEARL RIVER NEW YØRK)	300238
INVESTIGATION OF TITANIUM BORONITRIDE AND TANTALUM BOROCARBIDE	300238
MATERIAL SYSTEMS	300238
QUARTERLY REPT NØ 2 (1961) CONTRACT DA30-069-ØRD-3126	300238
ØRD PRØJ TB4-004 DA PRØJ 5B93-32-004 REPT WAL TR 371.9/2	300238
AD 253669 (1961)	300238
FØRSYTH, J DALTE DA VEIGA, L	201713
(CAVENDISH LAB CAMBRIDGE ENGLAND)	201713
THE STRUCTURE OF THE U-PHASE CØ7 MØ6	201713
ACTA CRYST 15, 543 (1962)	201713
CA 57, 5390 (1962)	201713
FØRSYTHE, W WØRTHING, A	700507
THE PROPERTIES OF TUNGSTEN AND THE CHARACTERISTICS OF TUNGSTEN	700507
LAMPS	700507
ASTRØPHYS JØURNAL 61, 146 (1925)	700507
CA 19, 2170 (1925)	700507
FRAGA, S RANSIL, B	700644
STUDIES IN MOLECULAR STRUCTURE. V COMPUTED STRECTRØSCØPIC	700644
CONSTANTS FOR SELECTED DIATOMIC MOLECULES OF THE FIRST RØW	700644
J CHEM PHYS 35, 669 (1961)	700644

FRANCIS, A	301076
METALS OF THE PLATINUM GROUP AND RHODIUM	301076
METALLURGY ET LA CONSTRUCTION MECANIQUE 94, (1962)	301076
REV MET LIT 19, (1962)	301076
FRANCIS, E	601127
THORIUM DATA MANUAL	601127
UK AT ENERGY AUTHORITY IND GROUP IGR-R/R-303, 20 (1958)	601127
CA 53, 11005 (1959)	601127
FRANCIS, E	601536
(UNITED KINGDOM AT ENERGY HARWELL ENGLAND)	601536
THORIUM DATA MANUAL	601536
IGR-R/R-303 (1958)	601536
NSA 13, 11171 (1959)	601536
FRANK, R	201284
(GEN ELEC CO CINCINNATI OHIO)	201284
THE PRESENT AND FUTURE OF NIOBIUM ALLOYS	201284
MET SOC CONF 11, 237 (1960)	201284
CA 56, 3240 (1962)	201284
FRANTSEVICH, I LAVRENKO, V	200869
HIGH TEMPERATURE OXIDATION OF TUNGSTEN, MOLYBDENUM	200869
TANTALUM, AND RHENIUM IN RECRYSTALLIZED AND COLD-	200869
HARDENED STATES	200869
ISSLEDOVANIYA PO ZHAROPROCH SPLAVAN, AKAD NAUK	200869
SSSR INST MET IM AA BAIKOVA 4, 329 (1959)	200869
CA 55, 5279 (1961)	200869
FRANTSEVICH, I SHIANOVSKAIA, I	300513
THE FINE CRYSTAL STRUCTURE OF STRAINED RHENIUM	300513
DOKLADY AKAD NAUK SSSR 142, NO 6, 1291 (1962)	300513
BHT NO 2, 5 (1962)	300513
FRANZEN, H	202033
(UNIV OF KANSAS LAWRENCE KANSAS)	202033
THE HIGH TEMPERATURE VAPORIZATION OF SOME OXIDES AND	202033
SULFIDES OF TITANIUM	202033
DISS ABST 23, 2713 (1963)	202033
CA 58, 13149 (1963)	202033
FRANZEN, J HINTENBERGER, H	700970
MULTI-ATOMIC MOLECULAR IONS IN HIGH FREQUENCY SPARKS BETWEEN	700970
ELECTRODES FROM THE ELEMENTS BE, C, MG, AL, TI, FE, CU	700970
Z NATURFORSCH 16A, 535 (1961)	700970
NSA 15, 31438 (1961)	700970
CA 56, 6749 (1962)	700970
FRASER, P JARMAIN, W NICHOLLS, R	300145
VIBRATIONAL TRANSITION PROBABILITIES OF DIATOMIC MOLECULES	300145
COLLECTED RESULTS II, N2+, CN, C2, O2, TI0	300145
ASTROPHY J 119, 286 (1954)	300145
CA 48, 5644 (1954)	300145
FRERICH, R	301450
(NORTHWESTERN UNIV EVANSTON ILL)	301450
SUPERCONDUCTIVE FILMS MADE BY PROTECTED SPUTTERING	301450
OF TA OR Nb	301450
J APPL PHYS 33, 1898 (1962)	301450
CA58, 2955D (1963)	301450
FRIED, S	601021

(ARGONNE NAT LAB	LEMONT	ILLINOIS)	601021
THE CHEMISTRY AND CRYSTAL CHEMISTRY OF HEAVY ELEMENT			601021
COMPOUNDS			601021
PROC INTERN CONF PLACEFUL USES ATOMIC ENERGY, GENEVA			601021
1955 7, 235 (1956)			601021
CA 50, 14419 (1956)			601021
FRIEDERICH, E SITTIG, L			700766
PREPARATION AND PROPERTIES OF NITRIDES			700766
Z ANORG CHEMIE 143, 293 (1925)			700766
CA 19, 1669 (1925)			700766
FRIES, R			300591
(LOS ALAMOS SCI LAB	LOS ALAMOS	NEW MEX)	300591
VAPORIZATION BEHAVIOR OF NIOBIUM CARBIDE			300591
J CHEM PHYSICS 37, NO 2, 320 (1962)			300591
FRIES, R			601478
(LOS ALAMOS SCI LAB	LOS ALAMOS	NEW MEXICO)	601478
VAPORIZATION BEHAVIOR OF NIOBIUM CARBIDE			601478
J CHEM PHYS 37, 320 (1962)			601478
BHT NO 3, 26 (1962)			601478
FRIES, R KEMPTER, C			701000
(LASL	LOS ALAMOS	NEW MEX)	701000
DIMOLYBDENUM CARBIDE			701000
ANAL CHEM 32, 1898 (1960)			701000
CA 55, 4093 (1961)			701000
NSA 15, 4317 (1961)			701000
FRÖST, B			301451
(AT ENERGY RES ESTAB	HARWELL	ENGLAND)	301451
ADVANCES IN LIQUID METAL TECHNOLOGY			301451
J NUCL MATER 7, 109 (1962)			301451
CA58, 13533D (1963)			301451
FRÖUNFELKER, R SEITZ, M HIRTHE, W			701089
(MARQUETTE UNIV	MILWAUKEE	WISC)	701089
CRYSTALLOGRAPHIC DATA FOR THE HEXAGONAL CRYSTAL SYSTEM			701089
NUCL SCI ENG 14, 192 (1962)			701089
NSA 17, 2095 (1963)			701089
FRUCHART, R MICHEL, A			300241
A NEW BORIDE OF MANGANESE, MNB ₄			300241
COMPT REND 251, 2953 (1960)			300241
CA 55, 21940 (1961)			300241
FRYBURG, G PETRUS, H			700596
KINETICS OF THE OXIDATION OF PLATINUM			700596
J ELECTROCHEM SOC 108, 496 (1961)			700596
FUGET, C MASI, J			300243
THERMODYNAMIC FUNCTIONS FOR SELECTED COMPOUNDS			300243
REPT ON PROJ ZIP (1957) REPT NO CCC-1024-TR-263			300243
CONTRACT NO (S)52-1024-C			300243
AD 234271 (1960)			300243
CA 55, 24215 (1961)			300243
FUJISHIRO, S			300463
DISSOCIATION PRESSURE AND THERMODYNAMIC PROPERTIES OF VC AT			300463
HIGH TEMPERATURE			300463
TRANS JAPAN INST METALS 1, 125 (1960)			300463
BHTG NO 4, 6 (1962)			300463

CA 56, 4166 (1962)	300463
FUJISHIRO, S	601440
THE DISSOCIATION PRESSURE OF UC2 AT HIGH TEMPERATURE	601440
AND THE THERMODYNAMIC PROPERTIES	601440
NIPPON GENSIRYOKU GAKKAISHI 3, 913 (1961)	601440
NSA 16, 7910 (1962)	601440
FUJISHIRO, S GOKCEN, N	201015
(UNIV OF PENNSYLVANIA PHILADELPHIA PA)	201015
THE THERMODYNAMIC PROPERTIES OF CR3C2 AT HIGH TEMPERATURES	201015
TRANS AIME 221, 275 (1961)	201015
CA 55, 13254 (1961)	201015
FUJISHIRO, S GOKCEN, N	701012
(UNIV OF PA PA)	701012
THERMODYNAMIC PROPERTIES OF TIC AT HIGH TEMPERATURES	701012
J PHYS CHEM 65, 161 (1961)	701012
NSA 15, 9475 (1961)	701012
FUJISHIRO, S GOKCEN, N	601477
THERMODYNAMIC PROPERTIES OF VC AT HIGH TEMPERATURES	601477
J ELECTROCHEM SOC 109, 835 (1962)	601477
BHT NO 3, 26 (1962)	601477
FUNAKI, K UCHIMURA, K KUNIYA, Y	201609
(TOKYO INST TECHNOL TOKYO JAPAN)	201609
THERMODYNAMIC STUDY OF THE TI-BR SYSTEM	201609
KOGYO KAGAKU ZASSHI 64, 1914 (1961)	201609
CA 57, 2923 (1962)	201609
FUNAKI, K UCHIMURA, K MATSUNAGA, H	201688
(TOKYO INST TECHNOL TOKYO JAPAN)	201688
THE TITANIUM-IODINE SYSTEM	201688
KOGYO KAGAKU ZASSHI 64, 129 (1961)	201688
CA 57, 4279 (1962)	201688
FUNKE, V YUDKOVSKII, S	202034
OXIDATION OF TITANIUM BORIDE IRON GROUP METAL ALLOYS AT HIGH	202034
TEMPERATURES	202034
ZH FIZ KHIM 37, 1557 (1963)	202034
FUNKE, V F YUDKOVSKII, S I	301138
STRUCTURE AND PROPERTIES OF THE ALLOYS OF ZIRCONIUM DIBORIDE	301138
WITH IRON, COBALT AND NICKEL (ABRIDGEMENT)	301138
IZVESTIYA AKADEMII NAUK OTDELENIYE TEKHNIЧЕСКИХ НАУК	301138
METALLURGIYA I TOPLIVO NO 4, 1962 ORIG 126, TRANS 103	301138
COTS 63, 230 (1963)	301138
FUNKE, V SURSKAKOV, A YUDKOVSKII, S KUZNETSOV, K	301453
SHULEPOV, V YURKEVICH, T	301453
ELECTRICAL RESISTIVITY AND STRUCTURE OF THE COBALT-TUNGSTEN	301453
CARBIDE ALLLOY	301453
FIZ METALLOV I METALLOVEDENIE (USSR) 10 NO 2 207 AUG 1960	301453
PA 9144 JULY 1961	301453
FUNKE, V NOVIKOVA, T TUMANOV, VV	201704
STRUCTURE AND PROPERTIES OF ALLOYS OF THE TUNGSTEN-CARBON-	201704
COBALT-MOLYBDENUM SYSTEM	201704
IZV AKAD NAUK SSSR OTD TEKH NAUK MET I TOPLIVO 1962, NO 2	201704
113	201704
CA 57, 4440 (1962)	201704

FUNKE, V PANOV, V	201236
STRUCTURAL AND PHYSICOMECHANICAL PROPERTIES OF TI-WC-CO ALLOYS	201236
FIZ METAL I METALLOVED AKAD NAUK SSSR 12, 382 (1961)	201236
CA 56, 1253 (1962)	201236
FULKERSON, S	601361
APPARATUS FOR DETERMINING LINEAR THERMAL EXPANSIONS	601361
OF MATERIALS IN VACUUM OR CONTROLLED ATMOSPHERE	601361
ORNL 2856, (1960)	601361
NSA 14, 4511 (1960)	601361
FUNAKI, K TADAHARU, O	500117
(TOKYO INST TECHNOL TOKYO JAPAN)	500117
STUDIES ON THE METALLURGY OF MOLYBDENUM. II THE REDUCTION OF	500117
MOLYBDENUM TRIOXIDE WITH HYDROGEN	500117
J ELECTROCHEM SOC (JAPAN) 18, 198 (1950)	500117
CA 45, 2837 (1951)	500117
FUNAKI, K UCHIMURA, K	201006
THE SYSTEM TI-TICL ₄	201006
BULL TOKYO INST TECHNOL SER B NO 3, 191 (1960)	201006
CA 55, 13152 (1961)	201006
GAIDUKOV, G GAIDUKOV, M	301139
MAKING PLASTIC VANADIUM	301139
IZV SIBIRSK OTD AKAD NAUK SSSR 7, 29 (1962)	301139
BHT NO 1, P 8, (1963)	301139
GALCHENKO, G KORNILOV, A SKURATOV, S	201545
(M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	201545
DETERMINATION OF THE ENTHALPY OF FORMATION OF BORON NITRIDE	201545
ZHUR NEORG KHIM 5, 2651 (1960)	201545
CA 56, 15003 (1962)	201545
GALCHENKO, G KORNILOV, A SKURATOV, S	700916
(MOSCOW STATE UNIV MOSCOW RUSSIA)	700916
HEAT OF COMBUSTION OF BORON	700916
ZHUR NEORG KHIM 5, 2141 (1960)	700916
NSA 15, 10953 (1961)	700916
CA 56, 10999 (1962)	700916
GALCHENKO, G KORNILOV, A TIMOFEEV, B SHURATOV, S	300673
STANDARD HEAT OF FORMATION OF BORON OXIDE	300673
DOKLADY AKAD NAUK SSSR 127, 1016 (1959)	300673
CA 55, 26637 (1961)	300673
GALCHENKO, G TIMOFEEV, B SKURATOV, S	201544
(M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	201544
THE ENTHALPY OF FORMATION OF ALUMINUM FLUORIDE	201544
ZH NEORGAN KHIM 5, 2645 (1960)	201544
CA 56, 15002 (1962)	201544
GALKIN, N	201248
THERMODYNAMICS OF THE REDUCTION OF URANIUM	201248
TETRAFLUORIDE BY CA	201248
AT ENERGY (USSR) 11, 257 (1961)	201248
CA 56, 2045 (1962)	201248
GALLAGHER, J BEDARD, F JOHNSON, C	600741
MICROWAVE SPECTRUM OF N14O16	600741
PHYS REV 93, 729 (1954)	600741

CA 48, 6835 (1954)	600741
GALLAGHER, J JOHNSON, C	600742
UNCOUPLING EFFECTS IN THE MICROWAVE SPECTRUM OF NITRIC OXIDE	600742
PHYS REV 103, 1727 (1956)	600742
CA 50, 16393 (1956)	600742
GALLAGHER, J KING, W JOHNSON, C	600743
THE MICROWAVE SPECTRUM OF N15O16	600743
PHYS REV 98, 1551 (1955)	600743
CA 50, 10514 (1956)	600743
GALLOWAY, G	701078
(MICHIGAN STATE UNIV EAST LANSING MICH)	701078
INVESTIGATIONS INTO THE PREPARATION AND DECOMPOSITION	701078
OF SM B4 AND SM B6	701078
THESIS, DISS ABST 23, N03 (1962)	701078
NSA 17, 1509 (1963)	701078
GANDERNA, A HONIG, J	300224
INTERACTION OF OXYGEN WITH TITANIUM DIOXIDE	300224
J PHYS CHEM 63, 620 (1959)	300224
GANESAN, S	201559
(INDIAN INST SCI BANGALORE INDIA)	201559
TEMPERATURE VARIATION OF THE GRUENEISEN PARAMETER IN	201559
MAGNESIUM OXIDE	201559
CA 57, 78 (1962)	201559
GARBER, R GINDIN, I	700673
PHYSICAL PROPERTIES OF THE HIGH PURITY METALS	700673
USPEKHI FIZ NAUK 74, 31 (1961)	700673
CT N0 14, (1961)	700673
GARSTANG, R	100207
THE SPECTRUM OF ZETA CAPRICORN	100207
PUB ASTRON SOC PACIFIC 64, 227 (1952)	100207
CA 47, 964 (1953)	100207
GATES, D THADOS, G	201372
(NORTHWESTERN UNIV EVANSTON ILL)	201372
THE CRITICAL CONSTANTS OF THE ELEMENTS	201372
A. I. CH. E. JOURNAL 6, 50 (1960)	201372
CA 56, 8024 (1962)	201372
GATTOW, G	201756
DEFINITIONS AND CHARACTERISTICS OF MANGANESE-OXIDES AND	201756
HYDROXIDES	201756
BATTERIEN 16, 322 (1962)	201756
CA 57, 6848 (1962)	201756
GATTOW, G GLEMSER, O	700576
PREPARATION AND PROPERTIES OF MANGANESE DIOXIDE EPSILON-,	700576
BETA-, AND ALPHA-MANGANESE DIOXIDES, RAMSDELLITE, AND	700576
TRANSFORMATION OF MANGANESE DIOXIDE.	700576
Z ANORG U ALLGEM CHEM 309, 121 (1961)	700576
GATTOW, G GLEMSER, O	700577
MANGANESE OXIDES. PREPARATION AND PROPERTIES OF PYROLUSITE	700577
GAMMA AND ETA GROUPS OF PYROLUSITE	700577
Z ANORG U ALLGEM CHEM 309, 20 (1961)	700577
GAUME-MAHN, F	601048

REFRACTORY COMPOUNDS OF RARE EARTH METALS-BORIDES, CARBIDES, NITRIDES, SULFIDES	601048
BULL SOC CHIM FRANCE 1956, 1862 (1956)	601048
CA 51, 6968 (1957)	601048
GAUME-MAHN, F BLANCHARD, M	201520
REACTION BETWEEN MOLYBDENUM AND LIQUID CERIUM	201520
CA 56, 13745 (1962)	201520
COMPT. REND 254, 1082 (1962)	201520
GAYDON, A	600900
GREEN AND ORANGE BAND SPECTRA OF CAOH, CAOD AND CALCIUM OXIDE	600900
PROC ROY SOC 231, 437 (1955)	600900
CA 50, 674 (1956)	600900
GEBHARDT, E ELSSNER, G	301049
(MAX-PLANCK-INST STUTTGART GERMANY)	301049
THE SYSTEM UO ₂ -ZrO ₂	301049
PLANSEE PROC 1961, 133 (1962)	301049
CA 58, 5085 (1963)	301049
GEBHARDT, E SEGHEZZI, H FROMM, E	700645
EQUILIBRIUM STUDY OF THE SYSTEM TANTALUM-NITROGEN	700645
Z METALLK 52, 464 (1961)	700645
CT NO 16, (1961)	700645
GEBHARDT, J HERRINGTON, K	300217
REDUCTION OF CONTAMINATED RUTILE SURFACES BY DEGASSING	300217
J PHYS CHEM 62, 120 (1958)	300217
GEBHARDT, E SEGHEZZI, H DURRSCHNABEL, W	300330
RESEARCH IN THE ZR-O SYSTEM I THE ELECTRICAL RESISTANCE OF OXYGEN CONTAINING ZIRCONIUM	300330
J NUCLEAR MATERIALS 4, 241 (1961)	300330
BHT 4, 21 (1961)	300330
GEBHARDT, E ROTHENBASHER, R	202035
SYSTEM NI ₃ BIUM-OXYGEN	202035
Z METALLK 54, 443 (1963)	202035
GEBHARDT, E SEGHEZZI, H KEIL, H	601676
(MAX-PLANCK INST DUSSELDORF GERMANY)	601676
THE VAPORIZATION OF TA IN VACUUM	601676
Z METALLK 53, 524 (1962)	601676
BHT NO 4 (1962)	601676
GEISELMAN, D	201941
(UNION CARBIDE METALS CO NIAGRA FALLS N Y)	201941
THE METALLURGY OF SCANDIUM	201941
J LESS-COMMON METALS 4, 362 (1962)	201941
CA 57, 16262 (1962)	201941
GELD, P MATVEENKO, I ALYAMOVSKII, S	201913
(URAL BRANCH AKAD SCI USSR SVERDLOVSK)	201913
INTERMEDIATE PRODUCTS IN THE REDUCTION OF VANADIUM OXIDES WITH CARBON	201913
IZV SIBIRSK OTD AKAD NAUK SSSR 1962, NO 5, 59-69	201913
CA 57, 14697 (1962)	201913
GELD, P ALYAMOVSKII, S MATVEENKO, I	300200
BETA, DELTA, AND ZETA PHASES OF THE VANADIUM-OXYGEN SYSTEM	300200
ZHUR STRUKT KHIM 2, NO 3 301 (1961)	300200

CA 56, 8096 (1962)	300200
GELD, P GERTMAN, Y	300417
HEATS OF SOLUTION OF LIQUID TRANSITION METALS (4TH PERIOD) IN	300417
LIQUID SILICON	300417
FIZ METAL I METALLOVED AKAD NAUK SSSR 10, 299 (1960)	300417
CA 55, 4074 (1961)	300417
GELD, P KRENTSIS, R	202037
SOME THERMOPHYSICAL CHARACTERISTICS OF IRON SILICIDES	202037
FIZ METAL I METALLOVED 15, 63 (1963)	202037
CA 58, 9914 (1963)	202037
GELD, P KUSENKO, F	600803
THE HEAT CONTENT AND SPECIFIC HEAT OF OXIDE AND CARBIDES	600803
OF NIOBIUM AT HIGH TEMPERATURES	600803
IZVEST AKAD NAUK SSSR, OTDEL TEKH NAUK MET I TOPLIVO	600803
N0 2 79 (1960)	600803
CA 55, 16114 (1961)	600803
GELD, P LIUBIMOV, V	300380
NIOBIUM AND CARBON DIFFUSION IN NIOBIUM AND ITS CARBIDES	300380
IZV A N SSSR OTD TEKH NAUK MET I TOPL N0 6 119 (1961)	300380
RUSS ACC 14, N0 12 3317 (1962)	300380
CA 56, 7021 (1962)	300380
GELD P V LYUBIMOV V D	301223
KINETIC CHARACTERISTICS OF THE REDUCTION OF NIOBIUM PENTOXIDE	301223
BY HYDROGEN	301223
ZHUR PRIKLAD KHIM 35, 1472 (1962)	301223
COTS 65, 320 (1963)	301223
GELD P V MATVEYENKO I I ALYAMOVSKIY S I	301224
INTERMEDIATE PRODUCTS IN THE PROCESS OF REDUCTION OF VANADIUM	301224
OXIDES BY CARBON	301224
IZV AKAD NAUK SSSR SIBIRSK OTD 5, 59-69 (1962)	301224
AD 400762	301224
GELD, P SHVEIKIN, G	200996
KINETICS OF NIOBIUM PENTOXIDE REDUCTION BY MEANS OF CARBON IN	200996
VACUUM	200996
PRIMENEN VAKUUMA V MET AKAD-NAUK SSSR INST MET .M AA BAYKOVA	200996
1960, 101 (1960)	200996
CA 55, 13010 (1961)	200996
GELD, P TSKHAJ, V	202036
AVERAGE DENSITIES OF VALENCE ELECTRONS IN IRON-OXYGEN	202036
VANADIUM OXYGEN AND TITANIUM OXYGEN	202036
ZH STRUKT KHIM 4, N0 2 235, (1963)	202036
GELD P V TSKHAY V A	301225
MEAN DENSITIES OF VALENCE ELECTRONS IN FeOx, VOx, AND TiOx	301225
ZHUR STRUKTURNY KHIM 4, 235 (1963)	301225
COTS 67, 100 (1963)	301225
GELLES, S PICKETT, J	600867
STABILITY OF THE HIGH TEMPERATURE BETA PHASE IN	600867
BERYLLIUM AND BERYLLIUM ALLOYS	600867
NS 15, 9415 (1961)	600867
GERASIMOV, A KONEV, V TIMOFEEVA, N	300511
STUDY OF DIFFUSION IN METAL-GAS SYSTEMS VI THE SYSTEM	300511
W-C-N	300511

FIZ METAL I METALLOVED 11, 596 (1961)	300511
BHT NØ 3, 38 (1961)	300511
GERASIMOV, V GRØMØVA, A SHAPØVALØV, E	300445
DEVELOPMENTAL ELECTROCHEMICAL MEASUREMENT METHODS FOR	300445
TEMPERATURES UP TO 300 DEG C AND PRESSURES UP TO 100 KG/CM2	300445
RAZRABOTKA METODIKI ELIK IZ PRI TEMP DØ 300 DEG C I	300445
DAVLENI DØ 100 KG/CM2 (1961)	300445
CØTS NØ 50, 131 (1962)	300445
GERASIMOV, V KRESTOVNIKOV, A SHAKHOV, A	300207
CHEMICAL THERMODYNAMICS IN NONFERREROUS METALLURGY	300207
MØSCØW GØSUDARST NAUCH TEKH IZDØTEL LIT PØ CHERNØI I ISVETNØI	300207
MET, 23 (1960)	300207
GERASIMOV, Y VASILEVA, I CHUSØVA, T GEIDERIKH, V	300755
TIMØFEEVA, M	300755
STUDY ØF THERMODYNAMIC PROPERTIES ØF ØXIDES BY	300755
ELECTROMØTIVE-FØRCE MEASUREMENTS	300755
ZH FIZ KHIM 36, 358 (1962)	300755
CA 57, 4449 (1962)	300755
GERASIMOV, Y VASILEVA, I CHUSØVA, T GEIDERIKH, V	700999
TIMØFEEVA, M	700999
(MØSCØW STATE UNIV MØSCØW RUSSIA)	700999
THE USE ØF THE EMF METHOD IN STUDYING THE THERMODYNAMICS ØF	700999
LØWER TUNGSTEN ØXIDES AT HIGH TEMPERATURES	700999
DØKLADY AKAD NAUK SSSR 134, 1350 (1960)	700999
CA 55, 8023 (1961)	700999
NSA 15, 6407 (1961)	700999
GERDANIAN, P DØDE, M	201886
PRESSURE ØF Ø2 IN EQUILIBRIUM WITH URANIUM ØXIDES, UØ2+X	201886
CØMPT REND 255, 665 (1962)	201886
CA 57, 13404 (1962)	201886
GERDANIAN, P DØDE, M	300355
SUR LA NON-STØICHIØMETRIE DES ØXYDES D URANIUM	300355
CØMPTES REND 254, 1005 (1962)	300355
NSA 16, 16738 (1962)	300355
GERDS, A MALLET, M	600985
REACTION ØF NITRØGEN WITH, AND THE DIFFUSION ØF NITRØGEN	600985
IN, THØRIUM	600985
J ELECTROCHEM SØC 101, 175 (1954)	600985
CA 50, 40 (1956)	600985
GERSH, S	900215
THERMODYNAMIC PROPERTIES ØF NITRØGEN AT LØW TEMPERATURES	900215
AND PRESSURES UP TO 200 ATMØSPHERES	900215
KIZLØRØD 1947, NØ 5, 21 (1947)	900215
DEPT ØF INTERIOR TN7 E57 NØ 555	900215
GERTSRIKEN, S	301454
DIFFUSION ØF THERMAL VACANCIES	301454
AKAD NAUK UKR (SSR) NØ 14, 26 (1962)	301454
CA 58, 1185E (1963)	301454
GETTE, E FØØTE, F	700510
PRECISION DETERMINATION ØF LATTICE CØNSTANTS	700510
J CHEM PHYS 3, 605 (1935)	700510
CA 29, 77305 (1935)	700510

GIELISSE, P			201740
(OHIO STATE UNIV	COLUMBUS	(OHIO)	201740
PHASE EQUILIBRIUMS IN THE SYSTEM ALUMINA-BORON OXIDE-SILICA			201740
UNIV MICROFILMS (ANN ARBOR, MICH) ORDER NO 62-2136,			201740
DISSERTATION ABSTR 22, 4034 (1962)			201740
CA 57, 6671 (1962)			201740
GIELISSE, P ROCKETT, T SHEVLIN, T FOSTER, W			601573
(OHIO STATE UNIV	COLUMBUS	(OHIO)	601573
RESEARCH ON THE PHASE EQUILIBRIUM BETWEEN BORON OXIDES AND			601573
REFRACTORY OXIDES, INCLUDING SILICON AND ALUMINUM OXIDE,			601573
NP-11234 (1960)			601573
NSA 16, 9203 (1962)			601573
GIESSEN, B RUMP, I GRANT, N			301455
THE CONSTITUTION DIAGRAM OF TUNGSTEN-HAFNIUM			301455
AIME 227, 264 (1963)			301455
CA 58, 7677 (1963)			301455
GIESSEN B C GRANT N J			301226
(MASS INST TECH	CAMBRIDGE	MASS)	301226
AN X-RAY METHOD TO DETERMINE THE LIQUID IN HIGH-TEMPERATURE			301226
BINARY PHASE DIAGRAMS			301226
TRANS AIME 227, (2) 535 (1963)			301226
BHT NO 2, 39 (1963)			301226
GIESSEN, B RUMP, I GRANT, N			201433
(MIT	CAMBRIDGE	MASS)	201433
THE CONSTITUTION DIAGRAM TUNGSTEN-HAFNIUM			201433
TRANS AIME 224, 60 (1962)			201433
CA 56, 9839 (1962)			201433
GIESSEN, W NORDHIEM, R			201233
(M I T	CAMBRIDGE	MASS)	201233
THE CONSTITUTION DIAGRAM NI OBIUM-RHENIUM			201233
TRANS AIME 221, 1009 (1961)			201233
CA 56, 1250 (1962)			201233
GILBREATH, J			601314
(ARGONNE NATL LAB	LEMONT	ILL)	601314
SUMMARY REPT FOR JAN, FEB AND MAR 1952			601314
CHEM DIVISION SECT C-11			601314
ANL-4833 (1952)			601314
NSA 11, 7455 (1957)			601314
GILBREATH, J			601300
(ARGONNE NATL LAB	LEMONT	ILL)	601300
CHEM DIVISION SEC C-11 SUMMARY REPT FOR			601300
JULY, AUG AND SEPT 1952			601300
DECL FEB 12, 1957			601300
ANL-5000 (DEL)			601300
NSA 11, 9579 (1957)			601300
GILBREATH, J			601274
(ARGONNE NATL LAB	LEMONT	ILL)	601274
CHEMISTRY DIVISION SUMMARY REPT (FOR) JAN-JUN 53			601274
CONTRACT W-3 1-104-ENG-38			601274
ANL-5421			601274
NSA 9, 6868 (1955)			601274
GILBREATH, J SIMPSON, O			601333
(ARGONNE NATL LAB	LEMONT	ILL)	601333
CHEMISTRY DIVISION, SECTION C-11 SUMMARY REPORT FOR			601333

JULY, AUGUST AND SEPTEMBER 1952	601333
ANL-5000 DECL (1960)	601333
NSA 14, 18708 (1960)	601333
 GILLAM, E	 601680
(GE CENTRAL RES LAB WEMBLEY ENGLAND)	601680
A GEOMETRICAL RELATIONSHIP BETWEEN UC2 (TETRAGONAL)	601680
AND U2C3 (CUBIC)	601680
ACTA CRYST 15, 1183 (1962)	601680
BHT NO 4 (1962)	601680
 GILLES, P	 301142
(UNIV OF KANSAS LAWRENCE KANSAS)	301142
TERNARY SPECIES AT HIGH TEMPERATURES	301142
PURE APPL CHEM 5, 543 (1962)	301142
BHT NO 7, P 6, (1963)	301142
 GILLES, P	 300450
HIGH TEMPERATURE CHEMISTRY	300450
ANN REV PHYS CHEM 12, 355 (1961)	300450
BHTG NO 4, 1 (1962)	300450
 GILLES, P	 201334
(UNIV OF KANSAS LAWRENCE KANSAS)	201334
HIGH TEMP CHEMISTRY OF THE BINARY COMPOUNDS OF BORON	201334
ADVANCES IN CHEM SER NO 32, 53 (1961)	201334
CA 56, 5618 (1962)	201334
 GILLIAN, O JOHNSON, C GORDY, W	 600709
MICROWAVE SPECTROSCOPY IN THE REGION FROM TWO TO THREE	600709
MILLIMETERS	600709
PHYS REV 78, 140 (1950)	600709
CA 44, 6724 (1950)	600709
 GILMAN, J ROBERTS, B	 300300
ELASTIC CONSTANTS OF TITANIUM CARBIDE AND TITANIUM BORIDE	300300
J APP PHYS 32, 1405 (1961)	300300
CT 16, 92 (1961)	300300
 GINNINGS, D CORRUCINI, R	 601647
HEAT CAPACITIES AT HIGH TEMPERATURE OF URANIUM,	601647
URANIUM TRICHLORIDE, AND URANIUM TETRACHLORIDE	601647
J RES NAT BUR STDS 39, 309 (1947)	601647
 GIORGI, A SZKLARZ, E STORMS, E BOWMAN, A	 202039
INVESTIGATION OF TANTALUM CARBIDE NIOBIUM CARBIDE AND	202039
VANADIUM CARBIDE FOR SUPERCONDUCTIVITY	202039
PHYS REV 129, 1524 (1963)	202039
 GIVØRD, J	 201554
THE METALLURGY OF ZR	201554
REV MET 59, 23 (1962)	201554
CA 56, 15255 (1962)	201554
 GLADISHEVSKII, E KRIPYAKEVICH, P TESLYUK, M	 201880
ZARECHNYUK, O KUZMA, Y	201880
(I FRANKO STATE UNIV LVØV)	201880
CRYSTAL STRUCTURE OF SOME INTERMETALLIC COMPOUNDS	201880
KRISTALLOGRAFIYA 6, 267 (1961)	201880
CA 57, 13249 (1962)	201880
 GLADYSHEVSKII, E KUZMA, U KRIPYAKEVICH, P	 202040
CRYSTAL STRUCTURE OF THE COMPOUNDS TRI MANGANESE DI NICKEL	202040

SILICON TRI VANADIUM DI NICKEL SILICON TRI NIOBIUM DI NICKEL SILICON AND CHROMIUM AND TANTALUM COMPOUNDS RELATED TO THEM ZHUR STRUKT KHIM 4, 372 (1963)	202040 202040 202040 202040
GLADYSHEUSKII, E TYLKINA, M SAVITSKII, E (A N BYKOV STATE UNIV LVOV POLAND) KRISTALLOGRAFIYA 5, 877 (1960) AN X-RAY AND MICROSCOPIC STUDY OF ALLOYS OF HF AND RE CA 57, 162 (1962)	201564 201564 201564 201564 201564
GLASNER, A STEINBURG, M (HEBREW UNIV JERUSALEM ISRAEL) THERMAL DECOMPOSITION OF LANTHANUM OXALATE J INORG AND NUCLEAR CHEM 16, 279 (1961) CA 55, 13146 (1961)	201003 201003 201003 201003 201003
GLASSER, F (PENN STATE UNIV UNIV PARK PA) THE TERNARY SYSTEM $CaO-MnO-SiO_2$ J AM CERAM SOC 45, 242 (1962) CA 57, 6672 (1962)	201741 201741 201741 201741 201741
GLEISER, M FREE ENERGIES OF FORMATION OF GASEOUS METAL OXIDES TRANS MET SOC OF AIME 221, 300 (1961) CA 56, 11001 (1962)	700616 700616 700616 700616
GLEISER, M CHIPMAN, J FREE ENERGY OF FORMATION OF MOLYBDENUM OXIDE AND CARBIDE J PHYS CHEM 66, 1539 (1962) CA 57, 11928 (1962)	300607 300607 300607 300607
GLEISER, M CHIPMAN, J FREE ENERGY OF FORMATION OF TUNGSTEN CARBIDE TRANS MET SOC AIME 224, NO 6, 1278 (1962)	300886 300886 300886
GLEMSE, O HAESFLER, R (UNIV GÖTTINGEN GERMANY) GASEOUS HYDROXIDES IV GASEOUS HYDROXIDES OF MOLYBDENUM AND TUNGSTEN Z ANORG ALLGEM CHEM 316, 168 (1962) CA 57, 15897 (1962)	201927 201927 201927 201927 201927
GLEMSE, O MUELLER, A VOLATILIZATION OF Cr_2O_3 IN THE PRESENCE OF WATER VAPOR NATURWISSENSCHAFTEN 49, NO 12-14, 279 (1962) CT NO 16, 103 (1962)	300759 300759 300759 300759
GLEMSE, O WEIZENKORN, H POLYNUCLEAR GASEOUS IRON AND MANGANESE OXIDES NATURWISSENSCHAFTEN 48, 715 (1961) CA 56, 10924 (1962)	201441 201441 201441 201441
GLÖCKLER, G (DUKE UNIV DURHAM NC) HEAT OF DISSOCIATION OF NITROGEN PURE APPL CHEM 2, 49 (1961) CA 56, 6724 (1962)	300616 300616 300616 300616 300616
GLÖR, M WIELAND, K (UNIV BASEL BASEL SWITZ) THERMAL AND OPTICAL INVESTIGATION OF VAPORS OF NIOBIUM	201245 201245 201245

OXYCHLORIDE (NbOCl ₃)	201245
HELV CHIM ACTA 44, 1098 (1961)	201245
CA 56, 2011 (1962)	201245
GLUSHKOV V P	301221
THERMODYNAMIC PROPERTIES OF INDIVIDUAL SUBSTANCES	301221
VOL 1 CALCULATION OF THERMODYNAMIC PROPERTIES (1962)	301221
VOL 2 TABLES OF THERMODYNAMIC PROPERTIES (1962)	301221
MOSKVA IZD-VO AKAD NAUK SSSR	301221
RUSS ACC 15, NO 10, 2761 (1963)	301221
GÖCHE, O	600943
(U. LIBRE BRUSSELS BELGIUM)	600943
CRYSTAL STRUCTURE OF PLATINUM DIOXIDE	600943
BULL CLASSE SCI ACAD ROY BELG 37, 393 (1951)	600943
CA 46, 2868 (1952)	600943
GODFREY, L BELL, P STEARNS, H	600607
BIBLIOGRAPHY ON TUNGSTEN, ITS ALLOYS AND COMPOUNDS	600607
LAMS 2, 2401 (1959)	600607
NS 14, 18113 (1960)	600607
GODINA, N KELER, E	201336
THE STABILITY OF SOLID SOLUTIONS IN THE SYSTEMS ZrO ₂ - MgO,	201336
ZrO ₂ - CaO, HF ₂ - MgO, AND HF ₂ - CaO.	201336
OGNEUPORY 26, 426 (1961)	201336
CA 56, 5647 (1962)	201336
GODINA, N KELER, E RUDENKO, V	201522
INTERACTION OF HAFNIUM DIOXIDE WITH TITANIUM DIOXIDE	201522
ZH NEORGAN KHIM 5, 2795 (1960)	201522
CA 56, 13747 (1962)	201522
GODNEV, I	300832
CALCULATION OF THERMODYNAMIC FUNCTIONS	300832
FROM MOLECULAR DATA	300832
VYCHISLENIE TERMODINAMICHESKIKH	300832
FUNKTSII PO MOLEKULYARNYM DANNYM (1956)	300832
COTS 56, 295 (1962)	300832
GODNEV, I ALEKASANDROVSKAYA, A SVERDLIN, A	300893
CORRESPONDENCE OF THE FORCE CONSTANTS OF THE MOLECULES	300893
XY ₄ AND XY ₁ , WHERE X IS A IV SUBGROUP ELEMENT AND Y A HALOGEN	300893
ZHUR FIZ KHIM 36, 2609 (1962)	300893
GOKCEN, N FUJISHIRO, S	301456
(UNIV OF PENNSYLVANIA PHILADELPHIA PENN)	301456
THERMODYNAMIC PROPERTIES OF MN ₇ C ₃	301456
AIME 227, 542 (1963)	301456
CA 58, 13554 (1963)	301456
GOLDANSKIY, V KAGAN, Y	400589
THERMOCHEMICAL EFFECTS OF IONIZING RADIATION	400589
RUSSIAN REPORT, CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS,	400589
PROCEEDINGS OF A SYMPOSIUM 1, 47 (1960)	400589
CA 55, 25532 (1961)	400589
GOLDBERG, L MULLER, E	600710
CARBON MONOXIDE IN THE SUN	600710
ASTROPHYS J 118, 397 (1953)	600710
CA 48, 1803 (1954)	600710
GOLDSCHMIDT, H	200765

X-RAY INVESTIGATIONS OF SYSTEMS BETWEEN NI0BIUM PENT0XIDE AND CERTAIN ADDITIONAL 0XIDES	200765
METALLURGIA 62, 211 (1960)	200765
CA 55, 6981 (1961)	200765
G0LDSCHMIDT, H BRAND, J	301457
(BSA GR0UP CENTER BIRMINGHAM ENGLAND)	301457
THE TUNGSTEN-RICH REGION 0F THE SYSTEM TUNGSTEN-CARB0N	301457
J LESS-C0MM0N METALS 5, N0 2, 181 (1963)	301457
CA 58, 13551 (1963)	301457
G0LDSCHMIDT, H BRAND, J	201070
(BSA GR0UP RESEARCH CENTER BIRMINGHAM ENGLAND)	201070
THE C0NSTITUTION 0F THE CHR0MIUM-NI0BIUM-SILIC0N SYSTEM	201070
J LESS C0MM0N METALS 3, 34 (1961)	201070
CA 55, 16356 (1961)	201070
G0LDSCHMIDT, H BRAND, J	201069
(B S A GR0UP RESEARCH CENTER BIRMINGHAM ENGLAND)	201069
THE C0NSTITUTION 0F THE CHR0MIUM-NI0BIUM-M0LYBDENUM SYSTEM	201069
J LESS C0MM0N METALS 3, 44 (1961)	201069
CA 55, 16356 (1961)	201069
G0LDSCHMIDT, H BRAND, J	601626
(BIRMINGHAM SMALL ARMS LTD BIRMINGHAM ENGLAND)	601626
INVESTIGATION INT0 THE TUNGSTEN RICH REGIONS	601626
0F THE BINARY SYSTEMS TUNGSTEN-CARB0N,	601626
TUNGSTEN-B0R0N, AND TUNGSTEN BERYLLIUM	601626
PART I, TUNGSTEN-CARB0N EQUILIBRIUM SYSTEM	601626
ASD-TDR-62-25 PT 1	601626
NSA 16, 21022 (1962)	601626
G0LDSMITH, A HIRSCHH0RN, H WATERMAN, T	700930
(ILL INST 0F TECH CHICAGO ILL)	700930
THERM0PHYSICAL PR0PERTIES 0F S0LID MATERIALS II ALL0YS	700930
(MELTING TEMPERATURE AB0VE 1000 DEG F)	700930
WADC-TR-58-476 (1960)	700930
NSA 15, 14740 (1961)	700930
G0LDSTEIN, H	201018
(0HIO STATE UNIVERSITY C0LUMBUS 0HIO)	201018
VAP0RIZATION 0F LANTHANUM 0XIDE (LA203) AND NED0MIUM 0XIDE	201018
(ND203) AT ELEVATED TEMPERATURES	201018
UNIV MICROFILMS (ANN ARB0R MICH) LC CARD N0 MIC 60-6369	201018
DISSERTATION ABSTR 21, 2126 (1961)	201018
CA 55, 13961 (1961)	201018
G0LDSTEIN, H	601489
RARE EARTH 0XIDES, THE VAP0RIZATION 0F ND203	601489
AFS0R-TN-58-291 (1957)	601489
NSA 12, 11293 (1958)	601489
G0LDSTEIN, H	201216
(0HIO STATE UNIV C0LUMBUS 0HIO)	201216
VAP0RIZATION 0F LA203 AND ND203. DIS0CIATION ENERGIES 0F	201216
GASE0US LA0 AND ND0	201216
J PHYS CHEM 65, 1400 (1961)	201216
CA 56, 1006 (1962)	201216
G0LDSTEIN, H	601551
(0HIO STATE UNIV C0LUMBUS 0HIO)	601551
RARE EARTH 0XIDES III. THE HEAT CAPACITIES 0F Y203, LA203	601551
ND203 FR0M 16-3000 DEGREES K	601551

AFOSR-TR-58-1095 (1958)	601551
NSA 13, 3942 (1959)	601551
GOLDSTEIN, H WALSH, P WHITE, D	700889
RARE EARTHS 1. VAPORIZATION OF LA2O3 AND ND2O3 DISSOCIATION	700889
ENERGIES OF GASEOUS LAO AND NDO	700889
J. PHYS CHEM 65, 1400 (1961)	700889
GOLDSTEIN, H WALSH, P WHITE, D	700896
USE OF TANTALUM KNUDSEN CELLS IN HIGH TEMPERATURE	700896
THERMODYNAMIC STUDIES OF OXIDES	700896
J PHYS CHEM 64, 1087 (1960)	700896
CA 55, 3181 (1961)	700896
GOLDSTEIN, H NEILSON, E WALSH, P WHITE, D	700836
HEAT CAPACITY OF YTTRIUM OXIDE, LANTHANUM OXIDE AND	700836
NEODYMIUM OXIDE FROM 16 TO 300 DEG K	700836
J. PHYS CHEM 63, 1445 (1959)	700836
C.A. 54, 6287 (1960)	700836
GOLDSTEIN, H WALSH, P WHITE, D	201098
(OHIO STATE UNIV COLUMBUS OHIO)	201098
RARE EARTH OXIDES. 1. THE VAPORIZATION OF NEODYMIUM	201098
SESQUIOXIDE, ND2O3. DISSOCIATION ENERGY OF NDO AND TAO	201098
US ATOMIC ENERGY COMM AFOSR TN 58-291 (1958)	201098
CA 55, 18227 (1961)	201098
GOLDWATER, D DANFORTH, W	600691
THE EVAPORATION OF THORIUM METAL	600691
J FRANKLIN INST 270, 317 (1960)	600691
PA 64, 1851 (1961)	600691
GOLUBTSOV, I LAPITSKII, A SHIRYAYEV, V	701029
(MOSCOW STATE UNIV MOSCOW RUSSIA)	701029
THE PROBLEM OF THE VOLATILITY OF NIOBIUM OXIDES	701029
IZVESTIY VYSSHYKH UCHEB, ZAVEDENII, KHIM I KHIM, TEKHNOL 3, 571	701029
(1960)	701029
CA 55, 1116 (1961)	701029
NSA 15, 14769 (1961)	701029
GOLUBTSOVA, R	201150
COMPOSITION AND STRUCTURE OF TI-CR COMPOUND	201150
DOKLADY AKAU NAUK SSSR 137, 593 (1961)	201150
CA 55, 20876 (1961)	201150
GOLUBTSOVA, R	300174
NATURE OF A CHEMICAL COMPOUND IN THE TITANIUM SILICON SYSTEM	300174
DOKLADY AKAU NAUK SSSR 137, 859 (1961)	300174
CH TITLES NO 11 69 (1961)	300174
CA 56, 3235 (1962)	300174
GOLUTVIN, Y	300567
HEAT OF FORMATION AND THE NATURE OF THE CHEMICAL BOND OF	300567
TRANSITION-METAL SILICIDE	300567
ZHUR FIZ KHIM 36, 1315 (1962)	300567
GOLUTVIN, Y	400599
THE HEATS OF FORMATION OF TITANIUM SILICIDES	400599
ZHUR FIZ KHIM 30, 10, 2251 (1956)	400599
GOLUTVIN YU M	301229
HEATS OF FORMATION AND THE NATURE OF THE BONDS IN THE	301229
SILICIDES OF TRANSITION METALS	301229

RUSS J PHYS CHEM 36, 696 (1962)	301229
GOLUTVIN, Y KÖZLÖVSKAYA, T	300568
ENTHALPY AND HEAT CAPACITY IN THE SYSTEM VANADIUM-SILICON	300568
ZHUR FIZ KHIM 36, 362 (1962)	300568
GOLUTVIN, Y KÖZLÖVSKAYA, T	301458
VARIATION OF ENTHALPY AND HEAT CAPACITY IN THE	301458
VANADIUM-SILICON SYSTEM	301458
RUS J. PHYS CHEM 36 183 (1962)	301458
GOLUTVIN, Y KÖZLÖVSKAYA, T MASLENNIKOVA, E	301228
HEATS OF FORMATION AND HEAT CAPACITIES OF THE SYSTEM	301228
MANGANESE-SILICON	301228
ZH FIZ KHIM 37, 1362 (1963)	301228
GOLUTVIN, Y LYAN, T	700540
HEATS OF FORMATION, HEAT CONTENTS AND HEAT CAPACITIES OF	700540
CHROMIUM SILICIDES	700540
ZHUR FIZ KHIM 35, 129 (1961)	700540
GOLUTVIN, Y KÖZLÖVSKAYA, T	301093
(INST OF METALLURGY	USSR)
ENTHALPY AND HEAT CAPACITY IN THE SYSTEM VANADIUM SILICON	301093
ZHUR FIZ KHIM 36, 2362 (1962)	301093
GONIKBERG, M SHAKHOVSHAI, G BUTUZOV, V	601064
(INST CRYST ACAD SCI	MOSCOW
DETERMINATION OF THE HEAT OF TRANSFORMATION OF THE CERIUM PHASE	USSR)
ZHUR FIZ KHIM 31, 350 (1957)	601064
CA 51, 15242 (1957)	601064
GONSER, B	301459
RHENIUM	301459
(ELSEVIER PUBLISHING CO	AMSTERDAM 1962)
	301459
GOOD, W SCOTT, D LACINA, J MCCULLOUGH, J	300394
THE HEAT OF FORMATION OF SILICA	300394
J PHYS CHEM 66, 380 (1962)	300394
GOODMAN, B	100208
OCCURRENCE OF SUPERCONDUCTIVITY BELOW 1 DEGREE K	100208
PROC MBS SEMICENTENNIAL SYMPOSIUM, LOW TEMP PHYSICS, NATL BUR	100208
STDS 519, 71 (1952)	100208
CA 47, 2562 (1953)	100208
GOODMAN, B HILLAIRET, J VEYSSIE, J WEIL, L	201518
(INST FOURIER	GRENÖBLE
FRANCE)	201518
PROC INTERN CONF LOW TEMP PHYS 7TH TORÖNTÖ, ÖNT. 1960, 350-6	201518
BAND STRUCTURE AND SUPERCONDUCTING PROPERTIES OF SEVERAL	201518
GAMMA-U ALLOYS FROM MEASUREMENTS OF THEIR SPECIFIC HEATS	201518
BETWEEN 1 AND 4 DEGREES K	201518
CA 56, 13661 (1962)	201518
GOODMAN, L NÖLDEKE, G WALTHER, H	300789
SIGN OF THE HYPERFINE STRUCTURE SPLITTING OF THE 3D54S26S5/2	300789
GROUND STATE OF MN55	300789
Z PHYS (GERMANY) 167, 26 (1962)	300789
PA 65, 8061 (1962)	300789
GOODMAN, M	601331
THERMAL COEFFICIENT OF EXPANSION OF URANIUM BY	601331

MEANS OF BONDED WIRE RESISTANCE STRAIN GAGES	601331
ORNL-518 (1949)	601331
DECL FEB 4, (1960)	601331
NSA 14, 22031 (1960)	601331
 GOODMAN, P HOMONOFF, H	301460
STUDY OF MATERIALS FOR THERMIONIC CONVERTERS	301460
AD 273533 80P. 31 DEC 1961	301460
 GOODWIN, T	601547
(LIBRARY OF CONGRESS WASH DC)	601547
THERMAL PROPERTIES OF CERTAIN METALS PART II, IRON,	601547
BE, IR, PD, PT AND W	601547
WADC-TR-56-423	601547
NSA 13, 4722 (1959)	601547
 GOPAL, R HUSAIN, M	301461
(UNIV LUCKNOW INDIA)	301461
RELATION BETWEEN LATTICE ENERGY AND MELTING POINT OF SOME	301461
CRYSTALLINE SUBSTANCES OF SOME TRANSITION METALS	301461
J INDIAN CHEM SOC 39, 827 (1962)	301461
CA 58, 10806 (1963)	301461
 GOPENKO, V	200913
PREPARATION OF DI-AND TRICHLORIDES OF TITANIUM	200913
ZHUR PRIKLAD KHIM 33, 2600 (1960)	200913
CA 55, 7124 (1961)	200913
 GORBUNOV, N ET AL	300382
NEUTRON DIFFRACTION STUDY OF TITANIUM CARBIDE AND NITRIDE	300382
IZV A N SSSR OTD KHIM NAUK NO 11 2093 (1961)	300382
RUSS ACC 14, NO 11 3077 (1962)	300382
 GORDON, G SCHEVBRMANN, C SPEISER, R	201499
(OHIO STATE UNIV COLUMBUS OHIO)	201499
THE OXIDATION CHARACTERISTICS OF NIOBIUM ALLOYS	201499
U S DEPT COM OFFICE TECH SERV	201499
PB REPT 145 (1960)	201499
CA 56, 12639 (1962)	201499
 GORDON, J	300639
(THIOKOL CHEM CORP DENVER NJ)	300639
THERMODYNAMIC FUNCTIONS FOR EIGHTEEN ELEMENTS	300639
TAKEN AS IDEAL GASES	300639
J CHEM PHYS 35, 2252 (1961)	300639
AM DOC INST DOC 6930 (PHOTOPRINT 3.75)	300639
CA 56, 12375 (1962)	300639
 GORDON, R	202041
(YALE UNIV NEW HAVEN CONN)	202041
STRUCTURE OF LIQUID METALS	202041
USAF TID-11882 (1961)	202041
CA 59, 8428 (1963)	202041
 GORELIK C C ELYUTIN V P	301230
RONTGENOGRAPHIC INVESTIGATION OF THE RECRYSTALLIZATION	301230
PROCESSES OF THE BORIDES OF TITANIUM ZIRCONIUM AND MOLYBDENUM	301230
AND THE CARBIDES OF TITANIUM AND TUNGSTEN	301230
IZV VUZ TSVET MET 5, NO 4, 143 (1962)	301230
AD 299169	301230
OTS 62-33685	301230
TAB 63-2-6, 135 (1963)	301230

GORELIK, S ELYUTIN, V MOZZHUKHIN, E URAZALIEV, U FUNKS, V (STEEL INST MOSCOW RUSSIA)	201947 201947 201947 201947 201947 201947
X RAY STUDY OF CRYSTALLIZATION OF TITANIUM, ZIRCONIUM AND MOLYBDENUM BORIDES, AND OF TITANIUM AND TUNGSTEN CARBIDES IZV VYSSHIKH UCHEBN ZAVEDENII TSVETN MET 5, NO 4, 143 (1962) CA 57, 16272 (1962)	
GOROKHOV, L (M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	300895 300895 300895 300895 300895 300895
NEW CALCULATIONAL METHODS IN MASS-SPECTROMETRIC STUDIES WITH A DOUBLE EFFUSION CHAMBER, AND THE THERMODYNAMIC PROPERTIES OF LII DANSSSR 142, NO 1, 113 (1962)	
GOUPIL, R POTENTIAL ENERGY OF THE TRIATOMIC MOLECULE C3 AND THE ORIGIN OF THE GROUP AT 4050A OF COMET NUCLEI COMPT REND 236, 1542 (1953) CA 47, 7318 (1953)	600684 600684 600684 600684 600684
GOUTER, E STRUCTURAL RELATIONSHIPS OF TERNARY TRANSITION METAL OXIDES XVII INTERNAT CONGRESS PURE AND APPL CHEM 1, 303 (1959)	700608 700608 700608
GOWARD, G HERSHENSØN, H COMMENT IN EVIDENCE OF METALLIC BONDING IN TI N ACTA MET 11, 637 (1963)	202042 202042 202042
GRAHAM, J LATTICE SPACINGS AND COLOR IN THE SYSTEM ALUMINA-CHROMIC OXIDE PHYS AND CHEM SOLIDS 17, 18 (1960) CA 55, 18237 (1961)	600818 600818 600818 600818 600818
GRAHAM, J WADSLEY, A (CSIRO CHEM RESEARCH LAB MELBOURNE AUSTRALIA)	201026 201026 201026 201026 201026
A CRYSTALLOGRAPHIC EXAMINATION OF TUNGSTEN TRIOXIDE WHISKERS ACTA CRYST 14, 379 (1961) CA 55, 14004 (1961)	
GRANT, F (NATL BUR OF STANDARDS WASHINGTON DC)	300890 300890 300890 300890
PROPERTIES OF RUTILE REV MOD PHYS 31, 646 (1959)	
GRAIN, C CAMPBELL, W BUREAU MINES ALBANY OREGON	601471 601471 601471 601471 601471
THERMAL EXPANSION AND PHASE INVERSION OF SIX REFRACTORY OXIDES BM-RI-5982 (1961) NSA 16, 19338 (1962)	
GRATTON, L THE SPECTRA OF K GIANTS. I. A TABLE OF WAVE LENGTHS AND IDENTIFICATION OF SPECTRAL LINES IN THE REGION 4000-5000 ANGSTROMS ASTRO PHYS J 115, 346 (1952) CA 46, 9975 (1952)	400567 400567 400567 400567 400567 400567
GRAVEN, W (AERONUTRONIC NEWPORT BEACH CALIF)	201519 201519 201519 201519 201519
J CHEM PHYS 35, 1526 (1961) ABSORPTION SPECTRA OF ANODIC TANTALUM OXIDE FILMS CA 56, 13667 (1962)	

GRAVEN, W SALOMON, R ADAMS, G	200911
ABSORPTION SPECTRA OF ANODIC NIOBIUM OXIDE FILMS	200911
J CHEM PHYS 33, 954 (1960)	200911
CA 55, 7035 (1961)	200911
GREBENSHCHIKOV, R	200973
ANALOGY OF THE PHYSICOCHEMICAL PROPERTIES OF BEF ₂ AND SiO ₂	200973
KHIM I PRAKT PRIMENENIE SILIKATOV INST KHIM SILIKATOV	200973
AKAD NAUK SSSR 1960, 18 (1960)	200973
CA 55, 11986 (1961)	200973
GREEN, J POLAND, D MARGRAVE, J	200782
THERMODYNAMIC PROPERTIES OF UNIPOSITIVE GASEOUS	200782
ELEMENTAL IONS	200782
J CHEM PHYS 33, 35 (1960)	200782
CA 55, 88 (1961)	200782
GREEN, J POLAND, D MARGRAVE, J	300353
ERRATUM-THERMODYNAMIC PROPERTIES OF UNIPOSITIVE GASEOUS	300353
ELEMENTAL IONS	300353
J CHEM PHYSICS 36, NO 4 1088 (1962)	300353
GREEN, J POLAND, D MARGRAVE, J	700882
THERMODYNAMIC PROPERTIES OF UNIPOSITIVE GASEOUS ELEMENTAL IONS	700882
J CHEM PHYS 33, 35 (1960)	700882
CA 55, 88 (1961)	700882
GREEN, J POLAND, D MARGRAVE, J	301462
THERMODYNAMIC PROPERTIES OF IONS AT HIGH TEMPERATURES	301462
AD 275 542 DEC 1961	301462
GREEN, M	300636
TRIATOMIC MOLECULES AND IONS CONTAINING NINETEEN	300636
VALENCY ELECTRONS	300636
J CHEM SOC 2819 (1962)	300636
GREENBAUM M A YATES R E	301231
(ROCKET POWER INC PASADENA CAL)	301231
STUDY OF ROCKET ENGINE EXHAUST PRODUCTS	301231
QUARTERLY REPT NO 6 SEPT-NOV (1962)	301231
AD 296321	301231
TAB 63, 31 (1963)	301231
GREENBERG, E SETTLE, J FEDER, H HUBBARD, W	300199
FLUORINE BOMB CALORIMETRY PART I HEAT OF FORMATION OF	300199
ZIRCONIUM TETRAFLUORIDE	300199
J PHYS CHEM 65, 1168 (1961)	300199
CA 55, 23023 (1961)	300199
GREENBERG, E SETTLE, J HUBBARD, W	300739
FLUORINE BOMB CALORIMETRY IV THE HEATS OF FORMATION OF	300739
TITANIUM AND HAFNIUM TETRAFLUORIDES	300739
J PHYS CHEM 66, 1345 (1962)	300739
GREENE, F	201357
(UNIV WISCONSIN MADISON WISC)	201357
SPECTRA AND THERMODYNAMICS OF SOME BORON SULFIDES AND OXIDES	201357
UNIV MICROFILMS (AN ARBOR, MICH) ORDER NO 61-5933, (1961)	201357
CA 56, 6797 (1962)	201357
GREENER E H FEHR G A HIRTHER W M	301232
(MARQUETTE UNIV MILWAUKEE WIS)	301232

ELECTRICAL CONDUCTIVITY OF NEAR-STOICHIOMETRIC ALPHA-NB2O5 IN THE TEMPERATURE RANGE 900 TO 1400 DEGREES J CHEM PHYS 38, 133-6 (1963) CA 58, 2931D (1963)	301232 301232 301232 301232
GREENER, E WHITMØRE, D NONOHMIC BEHAVIOR IN NEAR-STOICHIOMETRIC RUTILE(TiO2) J APPL PHYS 32, NØ 7, 1320 (1961) BHT NØ 3, 13 (1961) PA 64, 10035 (1961)	300487 300487 300487 300487 300487
GREENER, E WHITMØRE, D FINE, M THE ELECTRICAL CONDUCTIVITY OF NEAR STOICHIOMETRIC ALPHA-NB2O5 NP 9135 (1960) NS 14, 25943 (1930)	600631 600631 600631 600631
GREENER, E WHITMØRE, D FINE, M ELECTRICAL CONDUCTIVITY OF NEAR STOICHIOMETRIC ALPHA-NB2O5 J CHEM PHYS 34, 1017 (1961)	700527 700527 700527
GREENWOOD, N OSBØRN, A (UNIV NOTTINGHAM NOTTINGHAM ENGLAND) CHEMICAL AND MAGNETIC PROPERTIES OF LANTHANUM DICARBIDE AND SESQUICARBIDE J CHEM SOC 1961, 1775 (1961) CA 55, 17145 (1961)	201075 201075 201075 201075 201075 201075
GREGG, S HUSSEY, R JEPSON, W HIGH TEMP OXIDATION OF BERYLLIUM II THE REACTION WITH CARBON DIOXIDE AND WITH CARBON MONOXIDE J NUCLEAR MATERIALS 2, 225 (1960) CA 55, 5282 (1961)	200870 200870 200870 200870 200870
GREGG, S JEPSON, W (UNIV EXETER EXETER ENGLAND) THE OXIDATION OF CALCIUM IN MOIST OXYGEN J CHEM SOC 1961, 884 (1961) CA 55, 16247 (1961)	201062 201062 201062 201062 201062
GREGG, S (UNIV EXETER EXETER ENGLAND) THE HIGH TEMPERATURE OXIDATION OF BERYLLIUM III IN CO2, CO, AND CO-CO2 MIXTURES J NUCLEAR MATERIALS 3, 175 (1961) CA 55, 19668 (1961)	201133 201133 201133 201133 201133 201133
GREGG, S (UNIV EXETER EXETER ENGLAND) THE HIGH-TEMPERATURE OXIDATION OF BERYLLIUM V IN MOIST CARBON DIOXIDE AND MOIST CARBON MONOXIDE J NUCLEAR MATERIALS 4, 46 (1961) CA 56, 1268 (1962)	201244 201244 201244 201244 201244 201244
GREGØIRE, P COMPT REND 254, 125 (1962) REACTION BETWEEN POWERED U AND C INFLUENCE OF THE PREFERENTIAL ORIENTATION OF GRAPHITE CA 56, 12537 (1962)	201488 201488 201488 201488 201488
GREGØRY, N CONDENSATION COEFFICIENT AND THE VAPORIZATION PROCESS J PHYS CHEM 67, 618 (1963)	300892 300892 300892

GREGOREVA, V SEREDA, N	300398
REACTION OF TIC WITH CR AND MO	300398
POROSHKOVAYA MFT AKAD NAUK UKR SSSR 1, NO 2 48 (1961)	300398
CA 55, 2566 (1961)	300398
GRIBOV, L	900220
METHODS OF CALCULATION IN MOLECULAR SPECTROSCOPY	900220
IZ AK NAUK SSSR, XXVI, NO 10, 1226 (1962)	900220
JPRS 17176	900220
GRIDNEV, V TREFILOV, V MINAKOV, V	201093
MARTENSITE TRANSFORMATIONS IN THE TI-ZR SYSTEM	201093
DOKLADY AKAD NAUK SSSR 134, 1334 (1960)	201093
CA 55, 17444 (1961)	201093
GRIEVESON, P ALEOCK, C	301060
THE THERMODYNAMICS OF METAL SILICIDES AND SILICON CARBIDE	301060
SPEC ARANS PROC SYMPOSIUM BRITISH ARAN RES ASSO STOEKE ON TRENT	301060
CA 55, 25190 (1960)	301060
GRIFFEL, M	601263
(IOWA STATE COLL AMES IOWA)	601263
HEAT CAPACITY OF DYSPROSIUM FROM 15 TO 300 DEGREES K	601263
J CHEM PHYS 25, 75 (1956)	601263
NSA 10, 6585 (1956)	601263
GRIFFEL, M SKOCHDOPOLE, R	600966
(IOWA STATE COLL. AMES IOWA)	600966
HEAT CAPACITY AND ENTROPY OF THORIUM FROM 18 TO 300 DEG K	600966
J AM CHEM SOC 75, 5250 (1953)	600966
CA 48, 2462 (1954)	600966
NSA 8, 478 (1954)	600966
GRIFFEL, M SKOCHDOPOLE, R SPEDDING, F	601019
(IOWA STATE COLLEGE AMES IOWA)	601019
HEAT CAPACITY OF DYSPROSIUM FROM 15 TO 300 DEG K	601019
J CHEM PHYS 25, 75 (1956)	601019
CA 50, 14339 (1956)	601019
GRIFFITHS, L	201569
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	201569
NATURE 193, 362 (1962)	201569
EFFECT OF OXYGEN ON THE TEMPERATURE COEFFICIENT OF RESISTIVITY	201569
OF URANIUM MONOCARBIDE	201569
CA 57, 189 (1962)	201569
GRIGOREV, A SOKOLVSKAYA, E	201437
(VESTNIK MOSKOV UNIV KHIM MOSCOW RUSSIA)	201437
SOLID-STATE TRANSFORMATIONS IN CHROMIUM AND ITS ALLOYS	201437
SER 11 16, NO 6, 3 (1961)	201437
CA 56, 9847 (1962)	201437
GRIGOREV, A SOKOLOVSKAYA, E MAKSIMOVA, M SOKOLOVA, I	201646
NEDUMOV, N	201646
(MOSCOW STATE UNIV MOSCOW RUSSIA)	201646
POLYMORPHIC TRANSFORMATIONS OF CHROMIUM IN ALLOYS WITH	201646
TANTALUM	201646
ZH NEORGAN KHIM 5, 2640 (1960)	201646
CA 57, 4120 (1962)	201646
GRIGOREV, A SOKOLOVSKAYA, E NEDUMOV, N MAKSIMOVA, M	700620
SOKOLOVA, I YUI-PU, E	700620
POLYMORPHIC TRANSFORMATIONS OF CHROMIUM AND THE PHASE DIAGRAM	700620

OF THE CHROMIUM-NICKEL SYSTEM IN THE REGION RICH IN CHROMIUM ZHUR NEORG KHIM 6, 1248 (1961) CT NO 12, (1961)	700620 700620 700620
GRIGOREV, A SOKOLOVSKAYA, E SIMANOV, Y SOKOLOVA, I MARKSIMOVA, M PYATIGORSKAYA, L CONCERNING THE HIGH TEMPERATURE MODIFICATION OF CHROMIUM AND THE PHASE DIAGRAM OF CR-FE AT HIGH TEMPERATURES IN THE CHROMIUM-RICH COMPOSITION RANGE ZHUR NEORG KHIM 5, 2136 (1960) CA 55, 12712 (1961)	600912 600912 600912 600912 600912 600912 600912
GRIGOREV, A SOKOLOVSKAYA, E SIMANOV, Y SOKOLOVA, I PAVLON, V MAKSIMOVA, M HIGH TEMPERATURE MODIFICATIONS OF CHROMIUM AND CONSTITUTIONAL DIAGRAM OF THE SYSTEM CHROMIUM-MOLYBDENUM IN THE CHROMIUM RICH RANGE VESTNIK MOSKOV UNIV SER II, 15, NO 4, 23 (1960) CA 55, 8233 (1961)	600653 600653 600653 600653 600653 600653 600653
GRIGOREV, A YEH, Y SOKOLOVSKAYA, E (STATE UNIV MOSCOW RUSSIA) PHASE DIAGRAM OF THE SYSTEM CHROMIUM-COBALT IN THE CHROMIUM-RICH REGION ZH NEORGAN KHIM 5, 2642 (1960) CA 57, 8154 (1962)	201782 201782 201782 201782 201782 201782
GRIGOREVA, N SELEZNEVA, K DUGANOVA, V NI0BIUM PEROXIDE COMPOUNDS IZV AKAD NAUK USSR OTD KHIM NAUK 1962, NO 6, 937 (1962)	300888 300888 300888
GRIGOROVICH V K (U S AT ENERGY COMM USA) STRUCTURE OF LIQUID METALS & IR ELECTRONIC STRUCTURE AEC-TR-4879, 75-92 (1960) CA 58, 31 (1963)	301233 301233 301233 301233 301233
GRIGORYAN, L SIMANOV, Y SOLOVA, A (M V LOMONOSOV STATE UNIV MOSCOW RUSSIA) ALPHA, BETA AND GAMMA PHASES OF THE SYSTEM NI0BIUM-TELLURIUM DOKLADY AKAD NAUK SSSR 135, 1133 (1960) CA 55, 12986 (1961)	200992 200992 200992 200992 200992
GRIGORYEV, A T SOKOLOVSKAYA, E M SOLID STATE TRANSFORMATIONS IN CHROMIUM AND ITS ALLOYS VEST MOSK UNIV SER KHIM, VOL XVI NO 6, 3 (1961) DSIR RTS 2171 COTS, APRIL, 141 (1963)	301234 301234 301234 301234 301234
GRIMLEY, R BURNS, R INGRAM, M MASS-SPECTROMETRIC STUDY OF THE OSMIUM-OXYGEN SYSTEM J CHEM PHYS 33, 308 (1960) CA 55, 2268 (1961)	200817 200817 200817 200817
GRJOTHEIM, K HERSTAD, O TØGURI, J (TECH UNIV TRONDHEIM NORWAY) THE ALUMINUM REDUCTION OF MAGNESIUM OXIDE. I. THE VAPOR PRESSURE OF MAGNESIUM OVER THE SYSTEM AL-MG0 CAN J CHEM 39, 442 (1961) CA 55, 12971 (1961)	200990 200990 200990 200990 200990 200990
GRØNVOLD, F THE CRYSTAL STRUCTURE OF URANIUM OXIDE U308	601379 601379

NATURE 162, 70 (1948)	601379
NSA 1, 1075 (1948)	601379
GRØNVOLD, F	601001
(U OF ØSLØ ØSLØ NØRWAY)	601001
HIGH-TEMPERATURE X-RAY STUDY OF URANIUM OXIDES IN THE	601001
UO2-U3O8 REGION	601001
J INØRG NUCLEAR CHEM 1, 357 (1955)	601001
CA 50, 3881 (1956)	601001
GRØSS, P HAYMAN, C CLAYTON, H	601621
(FULMER INST STØKE PØGES ENGLAND)	601621
HEATS OF FORMATION OF URANIUM SILICIDES AND NITRIDES	601621
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,	601621
PRØC, VIENNA, MAY 1962	601621
NSA 16, 25832 (1962)	601621
GRØSS, P HAYMAN, C LEVI, D WILSON, G	300706
HEATS OF FORMATION OF METAL HALIDES-PENTABROMIDES OF	300706
NIØBIUM AND TANTALUM	300706
TRANS FAR SOC 58, 890 (1962)	300706
GRØSSE, A	202043
(TEMPLE UNIV PHILADELPHIA PA)	202043
THE EMPIRICAL RELATION BETWEEN THE ACTIVATION ENERGY OF	202043
VISCØSITY OF LIQUID METALS AND THEIR MELTING POINTS	202043
J INØRG NUCL CHEM 25, 317 (1963)	202043
CA 59, 2183 (1963)	202043
GRØSSE, A TEMPLE, U	301463
TEMPERATURE RANGE OF LIQUID METALS AND AN ESTIMATE OF	301463
THEIR CRITICAL CONSTANTS	301463
J. INØRG. NUCL CHEM 22, 23 (1961)	301463
CA 56, 14999 (1962)	301463
GRØSSE, A V	301236
(RES INST TEMPLE UNIV PHILADELPHIA PA)	301236
HIGH TEMPERATURE RESEARCH	301236
SCIENCE 140, (3568) 781 (1963)	301236
BHT NØ 2, 1 (1963)	301236
GRØSSE, A V KIRSHENBAUM, A D	301235
(TEMPLE UNIV PHILADELPHIA PA)	301235
THE DENSITIES OF LIQUID IRØN AND NICKEL AND AN ESTIMATE OF	301235
THEIR CRITICAL TEMPERATURE	301235
J INØRG-NUCL CHEM 25, (4) 331 (1963)	301235
BHT NØ 2, 34 (1963)	301235
GRØSSE, A LENTNER, H MURPHY, W STØKES, C	300578
THE HIGH TEMPERATURE CONTAINMENT OF SUBSTANCES	300578
ABØVE THE MELTING POINT OF THE CONTAINER	300578
J. AM. CHEM SOC 84, 3209 (1962)	300578
GRØSSE, A KIRSHENBAUM, A	301143
(TEMPLE UNIV RES INST PHILA PA)	301143
THE TEMPERATURE RANGE OF LIQUID PB AND AG AND AN ESTIMATE OF	301143
THEIR CRITICAL CONSTANTS	301143
J INØRG NUCL CHEM 24, 739 (1962)	301143
BHT NØ 1, P 40, (1963)	301143
GRØSSMAN, L	202044
QUESTION OF A PHASE CHANGE IN ZIRCØNIUM MONØCARBIDE	202044
J AM CERAM SOC 46, 457 (1963)	202044

GRÖSSMAN, L N		301237
(G E VALLECITOS ATOMIC LAB	PLEASANTON CALIF)	301237
HIGH TEMPERATURE THERMOPHYSICAL PROPERTIES OF UC		301237
J AM CERAM SOC 46, (6) 264 (1963)		301237
BHT NO 2, 28 (1963)		301237
GRÖZIFR, J		701018
(BETTS ATOMIC POWER LAB	PITTSBURG PA)	701018
THE EFFECT OF N2 ON THE LATTICE CONSTANTS AND HARDNESS OF		701018
ZIRCONIUM		701018
WAPD-ZH-26		701018
NSA 15, 11467 (1961)		701018
GRUEN, D KÖEHLER, W KATZ, J		400545
HIGHER OXIDES OF THE LANTHANIDE ELEMENTS, TERBIUM DIOXIDE		400545
J AM CHEM SOC 73, 1475 (1951)		400545
CA 45, 6885 (1951)		400545
GRUN, A		600581
THE GAYDON BANDS OF N2		600581
Z NATURFÖRSCH 9, 1017 (1954)		600581
CA 49, 6724 (1955)		600581
GSCHNEIDER, K		601093
RARE EARTH CARBON SYSTEMS		601093
UNIV MICROFILMS (ANN ARBOR MICH) L C CARD NO MIC 58-1040, 150		601093
CA 52, 10787 (1958)		601093
GSCHNEIDNER, K ELLIOTT, R MCDONALD, R		301464
(LOS ALAMOS SCI LAB	LOS ALAMOS NEW MEXICO)	301464
EFFECTS OF ALLOYING ADDITIONS ON THE ALPHA TO GAMMA AND		301464
GAMMA TO ALPHA TRANSFORMATION OF CERIUM III		301464
EFFECTS OF YTTRIUM AND RARE EARTH ADDITIONS		301464
PHYS CHEM SOLIDS 23, 201 (1962)		301464
CA 58, 2946 (1963)		301464
GSCHNEIDER, K		201700
(LOS ALAMOS SCI LAB	LOS ALAMOS NEW MEXICO)	201700
SOME COMMENTS ON THE YTTERBIUM-THORIUM SYSTEM		201700
J LESS COMMON METALS 4, NO 1 107 (1962)		201700
CA 57, 4435 (1962)		201700
GSCHNEIDER, K ELLIOTT, R MCDONALD, R		202045
(LOS ALAMOS SCI LAB	LOS ALAMOS N MEXICO)	202045
EFFECTS OF ALLOYING ADDITIONS OF SC, Y, RARE EARTHS,		202045
TH, AND PU, ON THE GAMMA TO ALPHA TRANSFORMATION OF		202045
CERIUM		202045
RARE EARTH RES SEMIN, LAKE ARROWHEAD 1960, 278 (1961)		202045
CA 58, 9930 (1963)		202045
GULL, J WÖRÖNCÖW, J		601580
(GE	CINCINNATI OHIO)	601580
BERYLLIUM RESEARCH IN THE USSR		601580
DC-59-3-188 (1959)		601580
NSA 16, 7882 (1962)		601580
GULBRANSEN, E		301465
(WESTINGHOUSE RES LABS	PITTSBURGH PA)	301465
HIGH-TEMPERATURE OXIDATION OF W, MO, AND		301465
NATURE 198, 82 (1963)		301465
CA 58, 13563 (1963)		301465

GULBRANSEN, E ANDREW, K	201770
(WESTINGHOUSE ELEC CORP PITTSBURGH PA)	201770
KINETICS OF THE OXIDATION OF PURE TUNGSTEN FROM 500 DEGREES TO	201770
1300 DEGREES	201770
J ELECTROCHEM SOC 107, 619 (1962)	201770
CA 57, 7963 (1962)	201770
GULBRANSEN, E ANDREW, K	300465
VAPOR PRESSURE STUDIES ON IRON AND CHROMIUM AND SEVERAL ALLOYS	300465
OF IRON CHROMIUM AND ALUMINUM	300465
TRANS AIME 221, 1247 (1961)	300465
REV MET LIT 19, (1962)	300465
BHTG NO 4, 7 (1962)	300465
GULBRANSEN, E ANDREW, K BLACKBURN, P COPAN, T MERLIN,	600638
OXIDATION OF TUNGSTEN AND TUNGSTEN BASED ALLOYS	600638
WADC-TR-59-575 (1959)	600638
CA 56, 8427 (1962)	600638
GULBRANSEN, E ANDREW, K BRASSART, F	300891
VAPOR PRESSURE OF MOLYBDENUM TRIOXIDE	300891
J ELECTROCHEM SOC 110, 242 (1963)	300891
GUMENYUK, V LEBEDEV, V	700553
HEAT AND ELECTRICAL CONDUCTIVITY OF TUNGSTEN AND GRAPHITE AT	700553
HIGH TEMPERATURES	700553
FIZ METAL I METALLOVED AKAD NAUK SSSR 11, 29 (1961)	700553
GUNN, S GREEN, L	201172
(LAWRENCE RADIATION LAB CAL)	201172
HEATS OF FORMATION OF SOME UNSTABLE GASEOUS HYDRIDES	201172
J PHYS CHEM 65, 779 (1961)	201172
CA 55, 23023 (1961)	201172
GURLEN, T	201792
OXIDATION OF NIOBIUM	201792
26-01 (DVADTSAT SHESTOI) MEZHDUNAR KONGRESS LITEISHCHIKOV	201792
(MOSCOW, GOS IZD MASHINOSTR LIT) SB 1959, 286 (1961)	201792
CA 57, 8315 (1962)	201792
GURVICH, L	600652
DETERMINATION OF HEAT OF SUBLIMATION OF METALS BY THE	600652
ANOMALOUS DISPERSION OF LIGHT CALCULATED WITH THE AID OF	600652
RÖZHDENSTVENSKIIS PROBABILITY METHOD. THERMODYNAMIC PROPERTIES	600652
AND HEATS OF SUBLIMATION OF GALLIUM, INDIUM AND THALLIUM	600652
ZHUR FIZ KHIM 34, 1691 (1960)	600652
CA 55, 9023 (1961)	600652
GURVICH, L KVLIVIDZE, V	300457
THERMODYNAMIC FUNCTIONS OF MONOATOMIC AND DIATOMIC GASES	300457
OVER A WIDE RANGE OF TEMPERATURES I METHOD OF CALCULATING	300457
THE THERMODYNAMIC FUNCTIONS OF IDEAL MONOATOMIC GASES	300457
ZHUR FIZ KHIM 35, 1672 (1961)	300457
BHTG NO 4, 2 (1962)	300457
GURVICH, I KVLIVIDZE, V RTISHCHEVA, N	400602
THERMODYNAMIC FUNCTIONS OF MONO-AND DI-ATOMIC METALS IN THE	400602
STATE OF IDEAL GASES UP TO 10,000K	400602
ZHUR FIZ KHIM 36, 1, 219 (1962)	400602
GURVICH, L YUNGMAN, V	300248
THERMODYNAMIC FUNCTIONS OF MONO AND DIATOMIC GASES OVER A	300248
BROAD RANGE OF TEMPERATURES II	300248

ZHUR FIZ KHIM 35, NO 9 1927 (1961) CA 56, 6721 (1962)	300248 300248
GURVICH, L YUNGMAN, V PRÖZÖRÖVSKII, E VÖRÖBEV, B CALCULATION OF THERMODYNAMIC FUNCTIONS OF DIATOMIC GASES AT HIGH TEMPERATURES BY THE METHOD OF DIRECT SUMMATION ON AN ELECTRONIC MACHINE TRUDY INST GÖRYUCH ISKÖPÖEM AKAD NAUK SSSR 12, 196 (1961) CA 56, 2951 (1962)	300354 300354 300354 300354 300354 300354
GUZMAN, I PÖLYBÖYARINÖV, D (MENDELEEV CHEM TECH INST MOSCÖW RUSSIA) SÖME PRÖPERTIES ÖF PÖRÖUS CERAMICS DERIVED FRÖM BERYLLIUM ÖXIDE ÖGNEUPÖRY 27, 457 (1962) CA 58, 1215 (1963) BHT NO 1, 35, (1963)	300894 300894 300894 300894 300894 300894
HABERMANN, C DAANE, A (IÖWA STATE UNIV AMES IÖWA) THE PREPARATION AND PRÖPERTIES ÖF DISTILLED YTTRIUM J LESS CÖMMÖN METALS 5, NO 2, 134 (1963) CA 58, 13536G (1963)	301466 301466 301466 301466 301466
HACK, M THE SPECTRUM ÖF EPSILON AURIGAE ASTRÖPHYS J 129, 291 (1959) CA 53, 14676 (1959)	601134 601134 601134 601134
HADDAD, R GÖLDWATER, D MÖRGAN, F THERMIÖNIC EMITTING PRÖPERTIES ÖF TWÖ REFRACTÖRIES J APPLIED PHYS 20, 1130 (1949)	300160 300160 300160
HADDAD, R GÖLDWATER, D MÖRGAN, F ZIRCÖNIUM CARBIDE AS A THERMIÖNIC EMITTER J APPLIED PHYS 20, 886 (1949)	300159 300159 300159
HAGENMÜLLER, P LESAICHERRE, A (FAC SCI BÖRDEAUX FRANCE) REDUCTIÖN ÖF V2Ö5 BY LIH. CÖMPT REND 256, 170 (1963) CA 58, 7603F (1963)	301467 301467 301467 301467 301467
HAHN, H CÖNCERNING THE VANADIUM-NITRÖGEN SYSTEM, METAL AMIDES AND METAL NITRIDES. XVIII. Z ANÖRG U ALLGEM CHEM 258, 58 (1949) AEC-TR-4657 NSA 15, 23993 (1961)	701046 701046 701046 701046 701046 701046
HAHN, W THERMÖDYNAMIC PRÖPERTIES ÖF ÖXIDE SÖLID SÖLUTIÖNS UNIV MICROFILMS (ANN ARBÖR, MICH.), L C CARD NO MIC 60-2157, DISSERTATIÖN ABSTR 21, 163 (1960) CA 55, 2260 (1961)	200812 200812 200812 200812 200812
HAKE, R (NÖRTH AM AVIATIÖN INC CANÖGA PARK CAL) LÖW-TEMPERATURE HEAT CAPACITIES ÖF SUPERCÖNDUCTING BÖDYCENTERED CUBIC TI-MÖ ALLÖYS PRÖC INTERN CÖNF LÖW TEMP PHYSICS., 7TH, TÖRÖNTÖ CAN. 1960, 359 (1961)	201456 201456 201456 201456 201456 201456

CA 56, 11001 (1962)	201456
HALDEN, F KINGERY, W	300161
METAL-CERAMIC INTERACTIONS V NOTE ON REACTIONS OF METALS	300161
WITH TITANIUM CARBIDE AND TITANIUM NITRIDE	300161
AM CERAM SOC BULL 34, NO 4 117 (1955)	300161
HALDEN, F WÖHLERS, H REINHART, R	201836
(STANFORD RES INST MENLO PARK CALIF)	201836
THERMAL EXPANSION OF URANIUM DIOXIDE	201836
U S AT ENERGY COMM TID-5722 (1959)	201836
CA 57, 11875 (1962)	201836
HALL, P LEGVOLD, S SPEDDING, F	601164
(IOWA STATE COLL AMES IOWA)	601164
ELECTRICAL RESISTIVITY OF YTTRIUM SINGLE CRYSTALS	601164
PHYS REV 116, 1446 (1959)	601164
CA 54, 23514 (1960)	601164
HAMAGUCHI, Y KUNITOMI, N KOMURA, S SAKAMOTO, M	201568
J PHYS SOC JAPAN 17, 398 (1962)	201568
ELECTRICAL RESISTIVITY OF UFE2 AND UMN2	201568
CA 57, 183 (1962)	201568
HAMAMURA, T	201386
(UNIV KYOTO JAPAN)	201386
REACTION OF WATER VAPOR WITH TUNGSTEN. I. RATE OF THE REACTION	201386
MEM FAC IND ARTS KYOTO TECH UNIV SCI TECHNOL NO 9, 1 (1960)	201386
CA 56, 8271 (1962)	201386
HAMPEL, C	200889
LESS COMMON ELEMENTS REFRACTORY METALS TANTALUM, NIOBIUM,	200889
MOLYBDENUM, RHENIUM AND TUNGSTEN	200889
IND ENG CHEM 53, 90 (1961)	200889
CA 55, 6318 (1961)	200889
HAMPEL, C	600951
THE RARE METALS HANDBOOK	600951
REINHOLD, N.Y. (1954)	600951
CA 48, 12003 (1954)	600951
HAMPSON, R DOOLING, J	201753
(CATHOLIC UNIV OF AM WASHINGTON D C)	201753
L C A O STUDY OF RE2	201753
U S DEPT COMM OFFICE TECH SERV P B REPT 154,987, (1960)	201753
CA 57, 6747 (1962)	201753
HAMPSON, R WALKER, R	700681
VAPOR PRESSURES OF PLATINUM, IRIIDIUM, AND RHODIUM	700681
J RES (NBS) 65A, 289 (1961)	700681
NSA 15, 29211 (1961)	700681
HANAK, J DAANF, A	201378
(IOWA STATE UNIV AMES IOWA)	201378
HIGH-TEMPERATURE X-RAY DIFFRACTION TECHNIQUES FOR ACTIVE	201378
METALS	201378
REV SCI INSTR 32, 712 (1961)	201378
CA 56, 8102 (1962)	201378
HANLIN, H	700951
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	700951
EVAPORATION RATE STUDIES	700951
NAA-SR-5785 (1960)	700951

NSA 15, 19834 (1961)	700951
HANTOS, R	601075
PREPARATION AND PROPERTIES OF METALLIC URANIUM	601075
KOHASZATI LAPOK 91, 27 (1958)	601075
CA 52, 18131 (1958)	601075
HARRIS, W	201239
(NATL RESEARCH COUNCIL WASH DC)	201239
CRITICAL COMPARISON OF NIObIUM WITH OTHER MATERIALS	201239
FOR MISSILE, AIRCRAFT AND NUCLEAR APPLICATIONS	201239
MET SOC CONF 10, 3 (1961)	201239
CA 56, 1257 (1962)	201239
HARRISON, W	301468
(GEN ELEC RES LAB SCHENECTADY N Y)	301468
ELECTRONIC STRUCTURE AND THE PROPERTIES OF METALS	301468
PHYS REV 129, 2503 (1963)	301468
CA 58, 8417 (1963)	301468
HARTLEY, C BAUN, W FISHER, D RAPPERPORT, E	201813
(WRIGHT AIR DEVL CENTER W PATTERSON A F B OHIO)	201813
PHASE RELATIONSHIPS IN TANTALUM-RICH TANTALUM-RUTHENIUM ALLOYS	201813
AT 1500 DEGREES	201813
U S DEPT COM OFFICE TECH SERV P B REPT 176,823 (1961)	201813
CA 57, 9547 (1962)	201813
HARTMANN, W	601519
(OAK RIDGE NATL LAB OAK RIDGE TENN)	601519
ELECTRICAL INVESTIGATION WITH OXIDE SEMICONDUCTORS	601519
Z PHYSIK 102, 709 (1936)	601519
AEC-TR-3784	601519
NSA 13, 21348 (1959)	601519
HARVEY, W	202047
THE THERMODYNAMIC ACTIVITY OF THE SEMICONDUCTOR	202047
PHYS CHEM SOLIDS 24, NO 5, 701 (1963)	202047
HARVEY, J KAUFMAN, L KULIN, S LEYENAAR, A UDIN, H	600640
RESEARCH AND DEVELOPMENT ON THE EFFECTS OF HIGH PRESSURE	600640
AND TEMPERATURE ON VARIOUS ELEMENTS AND BINARY ALLOYS	600640
WADC-TR-59-655 (1959)	600640
AD-240794	600640
NSA 15, 3099 (1961)	600640
HASAPIS, A PANISH, M ROSEN, C	700994
(AVCO RAD WILMINGTON MASS)	700994
THE VAPORIZATION AND PHYSICAL PROPERTIES OF CERTAIN	700994
REFRACTORIES. PART 1 TECHNIQUES AND PRELIMINARY STUDIES	700994
WADD-TR-60-463, PT 1 (1960)	700994
NSA 15, 5380 (1961)	700994
HASAPIS, A PANISH, M ROSEN, C	201939
(AVCO CORP WILMINGTON MASS)	201939
THE VAPORIZATION AND PHYSICAL PROPERTIES OF CERTAIN	201939
REFRACTORY 1. TECHNIQUE AND PRELIMINARY STUDIES	201939
U S DEPT COM OFFICE TECH SERV P B REPT 171,413, (1960)	201939
CA 57, 16161 (1962)	201939
HASAPIS, A MELVEGER, A PANISH, M REIF, L ROSEN, C	701017
(AVCO RAD WILMINGTON MASS)	701017
THE VAPORIZATION AND PHYSICAL PROPERTIES OF CERTAIN	701017
REFRACTORIES	701017

RAD-SR-16-61-1	701017
NSA 15, 11597 (1961)	701017
HASAPIS, A MELVEGER, A PANISH, M REIF, L RØSEN, C	701039
(AVCO RAD WILMINGTON MASS)	701039
THE VAPORIZATION AND PHYSICAL PROPERTIES OF CERTAIN	701039
REFRACTORIES	701039
RAD-SR-61-54 (1961)	701039
NSA 15, 19856 (1961)	701039
HASHIGUCHI, R MATSUURA, E ISHINO, S MINAMI, K	200856
ELECTRICAL RESISTIVITIES AND LATTICE CONSTANTS	200856
OF URANIUM DIOXIDE	200856
TRANS NATL RESEARCH INST METALS 2, NO 1, 1 (1960)	200856
CA 55, 5067 (1961)	200856
HATT, B	200929
(FULMER RESEARCH INST LTD STOKES PAGES ENGLAND)	200929
THE CRYSTAL STRUCTURES OF URE2	200929
ACTA CRYSTAL 14, 119 (1961)	200929
CA 55, 8989 (1961)	200929
HAUCK, J E	202048
GUIDE TO REFRACTORY CERAMICS	202048
MATER DESIGN ENG 58 (1), 85 (1963)	202048
CA 59, 8454 (1963)	202048
HAUFFE, K	601483
THE ELECTRICAL CONDUCTIVITY OF U-O SYST	601483
Z PHYSIK CHEM 46B, 124 (1941)	601483
NSA 12, 17933 (1958)	601483
HAUSNER, H	601530
(GLADDING MCREAN + CO INC LOS ANGELES CAL)	601530
BIBLIOGRAPHY ON UO2	601530
AECU-4142 (1959)	601530
NSA 13, 14499 (1959)	601530
HAUTECLER, S RØSEN, B	700759
ELECTRONIC SPECTRA OF SOME DIATOMIC OXIDES	700759
BULL CLASSE SCI, ACAD ROY BELG 45, 790 (1959)	700759
CA 54, 14929 (1960)	700759
HAVELL, R BASKIN, Y	201235
(ILL INST TECH CHICAGO ILL)	201235
RE-W-C INTERACTIONS	201235
J ELECTROCHEM SOC 108, 1068 (1961)	201235
CA 56, 1253 (1962)	201235
HAWORTH, C	201017
(UNIV SHEFFIELD SHEFFIELD ENGLAND)	201017
THE FORMATION OF INTERMEDIATE PHASE IN ALLOYS OF NB, TA, MO,	201017
AND W WITH OTHER TRANSITION METALS	201017
J LESS COMMON METALS 2, 125 (1960)	201017
CA 55, 13262 (1961)	201017
HEARD, J	400586
SPECTROSCOPIC OBSERVATIONS OF NOVA SCUTI	400586
ASTRONOMICAL JOURNAL 55, 73 (1950)	400586
CA 44, 6263 (1950)	400586
HECKINGBOTTOM, R LINNETT, J	300704
STRUCTURE OF VANADIUM DIOXIDE	704

NATURE 194, 678 (1962)	300704
HEDGE, J FIELDHOUSE, I	601294
(ILL INST OF TECH CHICAGO ILL)	601294
MEASUREMENT OF THERMAL CONDUCTIVITY OF UO ₂	601294
AECU-3381	601294
NSA 11, 1709 (1957)	601294
HEGEDUS, A SASVARI, K NEUGEBAUER, J	201144
(TUNGSTRAMS FACT INCAND LAMP BUDAPEST HUNGARY)	201144
THE INVESTIGATION OF THE REACTION BETWEEN TUNGSTEN TRIOXIDE	201144
AND CARBON MONOXIDE BY THERMAL AND X-RAY ANALYSIS	201144
ACTA CHIM ACAD SCI HUNGARY 26, 113 (1961)	201144
CA 55, 20747 (1961)	201144
HEGEDUS, A GADÓ, P	200788
MECHANISM OF THE REACTION OF TUNGSTEN TRIOXIDE WITH CARBON	200788
Z ANORG U ALLGEM CHEM 305, 227 (1960)	200788
CA 55, 195 (1961)	200788
HEGEDUS, A NEUGEBAUER, J	200789
THE MECHANISM OF THE REACTION OF MOLYBDENUM TRIOXIDE	200789
WITH CARBON	200789
Z ANORG U ALLGEM CHEM 305, 216 (1960)	200789
CA 55, 195 (1961)	200789
HELGØRSKY, J	201887
(UNIV PARIS PARIS FRANCE)	201887
SOLID REACTIONS IN THE SYSTEM ZIRCONIUM-TUNGSTEN-BORON	201887
ANN CHIM (PARIS) 6, 1339 (1961)	201887
CA 57, 13405 (1962)	201887
HELTEMES, F SWENSON, C	201411
(IOWA STATE UNIV AMES IOWA)	201411
NUCLEAR CONTRIBUTION TO THE HEAT CAPACITY OF TERBIUM METAL	201411
J CHEM PHYS 35, 1264 (1961)	201411
CA 56, 9509 (1962)	201411
HELVENSTØN, E	601195
LOWER OXIDATION STATES OF IRIIDIUM	601195
UNIV MICROFILMS MIC 59-4766	601195
DISSERTATION ABSTR 20,2007 (1959)	601195
CA 54, 6377 (1960)	601195
HENDERSØN, U	301469
(TEXACO EXPT INC RICHMOND VA)	301469
AD 273 733 QUALITY REPT NOV 61-JAN 62	301469
HENDRICKS, J B RISER, H N CLARK, C B	301239
CALCULATED VIBRATIONAL SPECTOR AND SPECIFIC HEATS OF LITHIUM	301239
AND VANADIUM	301239
PHYS REV 130, 1377 (1963)	301239
HENDRIE, J	600582
DISSOCIATION ENERGY OF N ₂	600582
J CHEM PHYS 22, 1503 (1954)	600582
CA 49, 20 (1955)	600582
HENGGE, E	201759
(UNIV MARBURG GERMANY)	201759
THE PREPARATION OF NEW SILICON SUBNITRIDE	201759
Z ANORG ALLGEM CHEM 315, 298 (1962)	201759
CA 57, 6851 (1962)	201759

HENNING, F WENSEL, H	900128
THE FREEZING POINT OF IRIIDIUM	900128
ANN PHYSIK 17, 620 (1933)	900128
CA 27, 4459 (1933)	900128
HEPNER, G HERMAN, L	600583
SPECTRUM OF NITROGEN BETWEEN 0.9 AND 2.6 MU	600583
ANN GEOPHYS 13, 242 (1957)	600583
CA 52, 3507 (1958)	600583
HERIC, E	202049
(UNIV GEORGIA	GEORGIA)
CONVERSION GRIDS FOR TERNARY SYSTEMS	202049
J CHEM EDUC 40 (6), 325 (1963)	202049
CA 59, 2213 (1963)	202049
HERING, H PERIO, P	601236
EQUILIBRIA OF URANIUM OXIDES BETWEEN UO ₂ AND U ₃ O ₈	601236
BULL SOC CHIM FRANCE 351 (1952)	601236
NSA 6, 3773 (1952)	601236
HERMAN, R	600586
NEW FORBIDDEN TRANSITION OF NITROGEN	600586
COMPT REND 233, 738 (1951)	600586
CA 46, 2396 (1952)	600586
HERMAN, R HERMAN, L	600555
EMISSION OF THE ATMOSPHERIC BANDS OF THE OXYGEN MOLECULE	600555
COMPT REND 229, 931 (1949)	600555
CA 44, 7652 (1950)	600555
HERMAN, R HERMAN, L	600557
EMISSION FROM OXYGEN DILUTED IN AN ATMOSPHERE OF XENON	600557
J PHYS RADIUM 11, 69 (1950)	600557
CA 44, 5703 (1950)	600557
HERMAN, L HERMAN, R	600584
SPECTRUM OF THE NITROGEN MOLECULE IN THE PHOTOGRAPHIC	600584
INFRARED	600584
MEM SOC ROY SCI LIEGE 12, 303 (1952)	600584
CA 46, 9978 (1952)	600584
HERMAN, R WENIGER, C	600556
EMISSION OF ATMOSPHERIC OXYGEN BANDS IN PURE OXYGEN	600556
COMPT REND 230, 940 (1950)	600556
CA 44, 5211 (1950)	600556
HERMAN, R WENIGER, C	600558
THE EMISSION OF THE PROHIBITED RADIATION BY MOLECULAR	600558
DECOMPOSITION	600558
COMPT REND 230, 1594 (1950)	600558
CA 44, 10496 (1950)	600558
HERMAN, R WENIGER, C	600585
EXCITATION OF THE HIGH ROTATIONAL LEVELS OF THE FIRST	600585
POSITIVE SYSTEM OF NITROGEN	600585
COMPT REND 234, 928 (1952)	600585
CA 46, 5964 (1952)	600585
HERRMANN, K DAANE, A SPEDDING, F	700905
PHYSICAL-METALLURGICAL PROPERTIES OF SCANDIUM, YTTRIUM AND THE	700905
RARE EARTH METALS	700905

ISC 702, USAEC (1955)	700905
CA 51, 2352 (1957)	700905
HERTZRICKEN, S SLYUSAR, B	300708
DETERMINATION OF THE ALLOTROPIC TRANSFORMATION HEAT	300708
IN TITANIUM, ZIRCONIUM, AND THE ALLOY TITANIUM	300708
PLUS 6.5 PCT CHROMIUM	300708
UKR FIZ ZH 7, NO 4, 439 (1962)	300708
HERZBERG, G	600536
FORBIDDEN TRANSITIONS IN THE SPECTRA OF DIATOMIC MOLECULES	600536
TRANS ROY SOC CANADA 46, III, 1 (1952)	600536
CA 47, 4185 (1953)	600536
HERZBERG, G	600537
FORBIDDEN TRANSITIONS IN DIATOMIC MOLECULES	600537
III. NEW ABSORPTION BANDS OF THE OXYGEN MOLECULE	600537
CAN J PHYS 31, 657 (1953)	600537
CA 48, 7428 (1954)	600537
HERZBERG, G	600538
FORBIDDEN TRANSITIONS IN DIATOMIC MOLECULES	600538
II NEW ABSORPTION BANDS OF THE OXYGEN MOLECULE	600538
CAN J PHYSICS 30, 185 (1952)	600538
CA 46, 9418 (1952)	600538
HERZBERG, G	200785
SPECTRA OF FREE RADICALS	200785
ANAL. REAL SOC ESPAN FIS Y QUIM 55A, 179 (1959)	200785
CA 55, 93 (1961)	200785
HERZBERG, G HUGO, T	600711
FORBIDDEN TRANSITIONS IN DIATOMIC MOLECULES IV THE ABSORPTION	600711
BANDS OF CARBON MONOXIDE	600711
CAN J PHYSICS 33, 757 (1955)	600711
CA 50, 2287 (1956)	600711
HERZBERG, G LAGERQVIST, A MIESCHER, E	600744
FINE STRUCTURE ANALYSIS AND MUTUAL PERTURBATION OF THE SAND	600744
DELTA AND BETA BANDS OF THE NO MOLECULE	600744
CAN J PHYS 34, 622 (1956)	600744
CA 50, 11108 (1956)	600744
HESLØP, R ROBINSON, P	301028
INORGANIC CHEMISTRY A GUIDE TO ADVANCED STUDY	301028
2ND ED NEW YORK.	301028
ELSEVIER PUB CO (1962)	301028
CA 58, 5252 (1963)	301028
HEXTER, R M	301240
EXCITATION-MODULATION SPECTROSCOPY A TECHNIQUE OF OBTAINING	301240
VIBRATIONAL SPECTRA OF EXCITED ELECTRONIC STATES	301240
J OPT SOC AM 53, NO 6, 703 (1963)	301240
HICKS, W	201011
(DUPONT WILMINGTON DEL)	201011
OXIDATION OF NIOBIUM MONOXIDE	201011
TRANS AIME 221, 352 (1961)	201011
CA 55, 13236 (1961)	201011
HIGGINS, J ANTILL, J	201606
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	201606
OXIDATION OF BERYLLIUM IN CARBON DIOXIDE AND OXYGEN	201606

J NUCL MATTER 5, 67 (1962)	201606
CA 57, 1952 (1962)	201606
HILDENBRAND, D THEARD, L	300219
AN EXPERIMENTAL PROGRAM FOR OBTAINING THE THERMODYNAMIC	300219
PROPERTIES OF PROPELLANT COMBUSTION PRODUCTS	300219
TAB 6124, AD 253233 (1961)	300219
HILDENBRAND, D HALL, W	202050
THE VAPORIZATION BEHAVIOR OF BORON NITRIDE AND ALUMINUM	202050
NITRIDE	202050
J PHYS CHEM 67, 888 (1963)	202050
HILDENBRAND, D L HALL, W F	301241
(FORD MOTOR CO NEWPORT BEACH CALIF)	301241
THE VAPORIZATION BEHAVIOR OF BN AND ALN	301241
J PHYS CHEM 67, (4) 888 (1963)	301241
BHT NO 2, 29 (1963)	301241
HILDENBRAND, D HALL, W POTTER, N	301470
(FORD MOTOR CO NEWPORT BEACH CALIF)	301470
THERMODYNAMICS OF VAPORIZATION OF LITHIUM OXIDE,	301470
BORIC OXIDE, AND LITHIUM METABORATE	301470
J CHEM PHYS 39, NO 2, 296 (1963)	301470
CA 59, 3372 (1963)	301470
HILL, D	201873
(ARGONNE NATL LAB ARGONNE ILL)	201873
PHASE RELATIONS AND CRYSTAL CHEMISTRY IN THE SYSTEM URANIUM	201873
OXIDE-LANTHANUM OXIDE	201873
J AM CERAM SOC 45, 258 (1962)	201873
CA 57, 13217 (1962)	201873
HILLER, M	700738
(IOWA STATE COLLEGE AMES IOWA)	700738
PHYSICAL AND CHEMICAL PROPERTIES OF SCANDIUM AND THE RARE	700738
EARTHS	700738
THESIS	700738
CA 54, 6377 (1960)	700738
HILL, H C REED, R I	301243
VOLATILIZATION OF HIGH MELTING SOLIDS IN A MASS SPECTROMETER	301243
J SCI INSTR 40, NO 5, 259 (1963)	301243
HILSENATH, J KLEIN, M WOOLLEY, H	300312
TABLES OF THERMODYNAMIC PROPERTIES OF AIR INCLUDING	300312
DISSOCIATION AND IONIZATION FROM 1500 TO 15000 DEG K	300312
US DEPT COM OTS PB 161,311 (1959)	300312
CA 55, 21713 (1961)	300312
HILSENATH, J ZIEGLER, G	301471
TABLES OF EINSTEIN FUNCTIONS	301471
NBS MONOGRAPH 49, (1962)	301471
J RES NBS 65A, 139 (1961)	301471
HINES, A ROSS, J	601592
ISOTOPE SHIFT IN THE SPECTRUM OF OSMIUM	601592
PHYS REV 125, 2105 (1962)	601592
NSA 16, 26317 (1962)	601592
HINZ, I DIETZEL, A	301472
(MAX-PLANCK INST WUERZBURG GERMANY)	301472
PHASE BOUNDARIES OF SOLID SOLUTIONS OF ZR02 AND MG0 FROM	301472

1800 DEGREES TO THE MELTING POINT BER DEUT KERAM GES 39, 530 (1962) CA 58, 8446 (1963)	301472 301472 301472
HINZ, I DIETZEL, A (MAX-PLANCK INST WUERZBURG GERMANY) PHASE INVERSION OF VARIOUS ZR02 SAMPLES BER DEUT KERAM GES 39, 489 (1962) CA 58, 2915 (1963)	301473 301473 301473 301473 301473
HIRSCH, A THE PREPARATION AND PROPERTIES OF METALLIC CERIUM TRANS ELECTROCHEM SOC 20, 57 (1911) CA 6, 48 (1912)	900097 900097 900097 900097
HIRSHFELD, A LEUPOLD, H B00RSE, H (COLUMBIA UNIV NEW YORK CITY NEW YORK) SUPERCONDUCTING AND NORMAL SPECIFIC HEAT OF NI0BIUM PHYS REV 127, 1501 (1962) CA 57, 15951 (1962)	201933 201933 201933 201933 201933
HIRSCHFELDER, J (UNIV OF WISCONSIN MADISON WISCONSIN) MATHEMATICAL BOTTLENECKS IN THEORETICAL CHEMISTRY US DEPT COM OFFICE TECH SERV PB REPT 158815, 117 (1959) CA 58, 938 (1963)	301474 301474 301474 301474 301474
HIRSCHFELDER, J SOME REMARKS ON THE THEORY OF FLAME PROPAGATION NINTH SYMPOSIUM ON COMBUSTION ACADEMIC PRESS N Y (1963)	202052 202052 202052
HIRSCHFELDER, J CURTIS, C BIRD, R MOLECULAR THEORY OF GASES AND LIQUIDS JOHN WILEY + SONS INC N Y (1954)	202051 202051 202051
HISATUNE, I THE SPECTRA OF NITROGEN OXIDES I THE SPECTRUM OF N2O4 US DEPT COM OFFICE TECH SERV P B REPT 143667 (1959) CA 55, 16141 (1961)	600807 600807 600807 600807
HOARD, J (CORNELL UNIV ITHACA NY) REMARKS ON STRUCTURE AND POLYMORPHISM IN BORON NSA 15, 7823 (1961)	700998 700998 700998 700998
HOARD, J STRUCTURE OF BETA-RHOMB0HEDRAL BORON J AM CHEM SOC 85, 361 (1963)	300901 300901 300901
H0CH, M ORDER-DISORDER REACTIONS IN ALPHA-TI(0) AND TI 0 J PHYS CHEM SOLIDS 24, 157 (1963)	202053 202053 202053
H0CH, M THERMODYNAMIC INVESTIGATION OF CERAMIC MATERIALS AT ELEVATED TEMPERATURES AD 266459	301475 301475 301475 301475
H0CH, M VARDI, J (UNIV OF CINCINNATI CINCINNATI OHIO) THERMAL CONDUCTIVITY OF TIC J AM CERAM SOC 46, 245 (1963) CA 59, 5800 (1963)	301476 301476 301476 301476 301476

HØCH, M		301477
(UNIV ØF CINCINNATI	CINCINNATI	ØHIØ)
VACANCY INTERACTION ENERGIES IN TRANSITION METAL ØXIDES		301477
J PHYS SOC JAPAN 18, 147 (1963)		301477
CA 59, 5890 (1963)		301477
 HØCH, M		201136
(UNIV ØF CINCINNATI	CINCINNATI	ØHIØ)
THE SYSTEM TI-ZR-Ø		201136
US DEPT CØM ØFFICE TECH SERV PB REPT 161435 (1959)		201136
CA 55, 19711 (1961)		201136
 HØCH, M		300311
THERMØDYNAMIC INVESTIGATION ØF CERAMIC MATERIALS AT ELEVATED		300311
TEMPERATURE		300311
AD 250752		300311
CØN AF 33(616)6299 PROJ 7021 (1961)		300311
 HØCH, M		700661
(CIN UNIV RES FØUND	CINCINNATI	ØHIØ)
THERMØDYNAMIC INVESTIGATION ØF CERAMIC MATERIALS AT ELEVATED		700661
TEMPERATURES		700661
AD-255085 (8 MAY 1961)		700661
GR 36, NØ 1, 105 (1961)		700661
NSA 15, 32530 (1961)		700661
 HØCH, M		300544
THERMØDYNAMICS ØF TRANSITION METAL ALLØYS GROUP IV,V, AND		300544
VI ELEMENTS		300544
TRANS AIME 224, NØ 2, 379 (1962)		300544
BHT NØ 2, 41 (1962)		300544
 HØCH, M DEAN, R HWU, C WØLØSIN, S		300545
THE SYSTEM TI-ZR-Ø		300545
TRANS AIME 221, NØ 6, 1162 (1961)		300545
BHT NØ 2, 41 (1962)		300545
 HØCH, M DEAN, R HWU, C WØLØSIN, S		300214
THE SYSTEM TITANIUM-ZIRCØNIUM, ØXYGEN		300214
US DEPT CØMM ØTS PB 161435 PAGE 74 (1959)		300214
CA 55, 19711 (1961)		300214
 HØCH, M DESJARDINS, M		300899
SYSTEM MØLYBDENUM-TITANIUM-ZIRCØNIUM-ØXYGEN AT 1500 DEGREES C		300899
TRANS MET SOC AIME 224, NØ 4, 821 (1962)		300899
 HØCH, M JØHNSTØN, H		700613
A HIGH TEMPERATURE DRØP CALØRIMETER. THE HEAT CAPACITIES ØF		700613
TANTALUM AND TUNGSTEN BETWEEN 1000 DEGREES AND 3000 DEGREES K		700613
J PHYS CHEM 65, 855 (1961)		700613
 HØCH, M MATHUR, M		300587
(UNIV ØF CINCINNATI	CINCINNATI	ØHIØ)
FØRMATION ØF CUBIC ZRØ2 WITH TRANSITION METALS ØF		300587
GRØUPS V AND VI AND THEIR ØXIDES		300587
J AM CERAMIC SOC 45, NØ 8, 373 (1962)		300587
 HØCH, M JØHNSTØN, H		600972
(ØHIØ STATE U	CØLUMBUS	ØHIØ)
THE REACTION ØCCURRING ØN THØRIATED CATHØDES		600972
J AM CHEM SOC 76, 4833 (1954)		600972
CA 49, 1464 (1955)		600972

HØCH, M JOHNSTON, H			201167
(ØHIØ STATE UNIV	CØLUMBUS	ØHIØ)	201167
HIGH TEMPERATURE DRØP CALØRIMETER. THE HEAT CAPACITIES			201167
ØF TA AND W BETWEEN 1000 DEGREES AND 3000 DEGREES K			201167
J PHYS CHEM 65, 855 (1961)			201167
CA 55, 22946 (1961)			201167
HØCH, M JOHNSTON, H			201171
(ØHIØ STATE UNIV	CØLUMBUS	ØHIØ)	201171
THE HEAT CAPACITIES ØF ALUMINUM ØXIDE FRØM 1000 TØ 2000 DEGREES			201171
AND ØF THØRIUM DIOXIDE FRØM 1000 TØ 2500 DEGREES			201171
J PHYS CHEM 65, 1184 (1961)			201171
CA 55, 23022 (1961)			201171
HØCH, M IYER, A NELKEN, J			300897
INTERACTION ENERGIES ØF VACANCIES IN TRANSITION METAL ØXIDES			300897
WITH LARGE CØNCENTRATION ØF VACANCIES			300897
PHYS CHEM SØLIDS 23, 1463 (1962)			300897
CA 58, 74 (1963)			300897
HØCH, M VARDI, J			301245
(UNIV ØF CINCINNATI	CINCINNATI	ØHIØ)	301245
THERMAL CØNDUCTIVITY ØF TIC			301245
J AM CERAM SØC 46, (5) 245 (1963)			301245
BHT NØ 2, 29 (1963)			301245
HØCHSTIM, A			300898
THEØRETICAL CALCULATION ØF THERMØDYNAMIC PRØPERTIES ØF AIR			300898
AD 283497 (1962)			300898
HØDGF, W			700659
REVIEW ØF RECENT DEVELØPMENTS IN THE METALLURGY ØF BERYLLIUM			700659
AD-256206 (17 MAY 1961)			700659
GR 36, NØ 2, 91 (1961)			700659
HØEKSTRA, H			201177
(ARGØNNE NATL LAB	LEMØNT	ILL)	201177
LØW TEMPERATURE ØXIDATION ØF UØ2 AND U4Ø9			201177
J INØRG AND NUCLEAR CHEM 18, 166 (1961)			201177
CA 55, 23147 (1961)			201177
HØEKSTRA, H			601280
(ARGØNNE NATL LAB	LEMØNT	ILL)	601280
THE URANIUM SYST UØ2.5 TØ U3Ø8			601280
J PHYS CHEM 59, 136 (1955)			601280
NSA 9, 2685 (1955)			601280
HØEKSTRA, H KATZ, J			601188
STUDIES ØN THE URANIUM-ØXYGEN SYSTEM			601188
AECD 2954 PC-1240 (1950)			601188
NSA 5, 591 (1951)			601188
HØEKSTRA, H SIEGEL, S			601209
THE URANIUM-ØXYGEN SYSTEM U3Ø8 TØ UC^			601209
PRØC U N INTERN CØNF PEACEFUL USES AT ENERGY 2ND GENEVA			601209
28, 231 (1958)			601209
CA 54, 1054 (1960)			601209
HØEKSTRA, H SIEGEL, S			601022
(ARGØNNE NATL LAB	LEMØNT	ILL)	601022
RECENT DEVELØPMENTS IN THE CHEMISTRY ØF THE			601022
URANIUM-ØXYGEN SYSTEM			601022

PRØC INTERN CØNF PEACEFUL USES ATØMIC ENERGY, GENEVA, 1955 7, 394 (1956) CA 50, 14423 (1956)	601022 601022 601022
HØLDEN, A PHYSICAL METALLURGY ØF URANIUM (ADDISØN-WESLEY PUB CØ (1958) NSA 13, 243 (1959)	601562 601562 601562 601562
HØLLAND, L (BRYN MAWR CØLL BRYN MAWR PA) PHYSICAL PRØPERTIES ØF TITANIUM III THE SPECIFIC HEAT J APPL PHYS 34 (8), 2350 (1963) CA 59, 7029 (1963)	202054 202054 202054 202054 202054
HØLLAND, M (RAYTHEØN CØ WALTHAM MASS) LØW TEMPERATURE THERMAL CØNDUCTIVITY ØF SILICØN PRØC INTERN CØNF SEMICØNDUCTØR PHYS, PRAGUE 1960, 633 (1961) CA 56, 4114 (1962)	201289 201289 201289 201289 201289
HØLLANDER, L ELECTRICAL CØNDUCTIVITY AND THERMØELECTRIC EFFECT IN SINGLE- CRYSTAL TIC J APP PHYS 32, 996 (1961) PA 64, 11260 (1961)	700528 700528 700528 700528 700528
HØLLEY, C (LØS ALAMØS SCI LAB LØS ALAMØS NEW MEXICØ) THE THERMØDYNAMIC PRØPERTIES ØF THE URANIUM AND PLUTØNIUM CARBIDES LADC-5487 NSA 17, 149 (1963)	601690 601690 601690 601690 601690 601690
HØLLEY, C HUBER, E MEIERKØRD, E THE HEAT ØF CØMBUSTIØN ØF THØRIUM AND URANIUM AECU-1294 LADC-960 NSA 5, 3925 (1951)	601178 601178 601178 601178
HØLLIDAY, A TAYLØR, F (LIVERPØØL UNIV LIVERPØØL ENGLAND) DIBØRØN TETRAFLUØRIDE ITS DECOMPOSITION AND ITS REACTIONS WITH ØXYGEN AND NITRIC ØXIDE J CHEM SØC 1962, 2767 (1962) CA 57, 5555 (1962)	201724 201724 201724 201724 201724 201724
HØLLIDAY, J (US STEEL CØRP MØNRØEVILLE PA) SØFT X-RAY EMISSION SPECTRUM ØF NIØBIUM PHIL MAG 6, 801 (1961) CA 56, 1052 (1962)	201225 201225 201225 201225 201225
HØLLØWAY, H ENTHALPY ØF FØRMATION ØF ØXYGEN VACANCIES IN BAØ J CHEM PHYS 36, NØ 11, 2820 (1962) BHT NØ 2, 17 (1962)	300525 300525 300525 300525
HØLMBERG, B DISØRDER AND ØRDER IN SØLID SØLUTIØNS ØF ØXYGEN IN ALPHA-TITANIUM ACTA CHEMICA SCANDINAVICA 16, NØ 5, 1245 (1962)	300595 300595 300595 300595
HØLMBERG, B	300594

STRUCTURAL STUDIES ON THE TITANIUM-NITROGEN SYSTEM ACTA CHEMICA SCANDINAVICA 16, NO 5, 1255 (1962)	300594 300594
HOLMBERG, B DAGERHAMN, T X-RAY STUDIES ON SOLID SOLNS OF OXYGEN IN ALPHA-ZIRCONIUM ACTA CHEM SCAND 15, 919 (1961) BHT 4, 8 (1961)	300326 300326 300326 300326
HOLMES, J HOOVER, M (UNIV OF SOUTHERN CAL LOS ANGELES CAL) ISOTOPE SHIFT IN THE FIRST SPECTRUM OF SILICON (SI I) J OPT SOCIETY OF AMERICA 52, 247 (1962)	300822 300822 300822 300822
HOLMQUIST, S CONVERSION OF QUARTZ TO TRIDYMIT J AM CERAMIC SOC 44, 82 (1961)	700517 700517 700517
HONIG, J (PURDUE UNIV LAFAYETTE IND) LITERATURE REVIEW ON PROPERTIES OF PR AND CE OXIDES AFOSR-TN-58-57 (1958) PB-135200 (1958) CERAM ABST 44, 224 (1961) NSA 13, 14218 (1959)	601531 601531 601531 601531 601531 601531 601531
HONIG, R (RADIO CORP OF AM LABS PRINCETON N J) THE SPUTTERING OF SILICON CARBIDE BY POSITIVE-ION BOMBARDMENT PROC INTERN CONF IONIZATION PHENOMENA GASES 5TH MUNICH 1961, 106 (1962) CA 59, 7046 (1963)	202055 202055 202055 202055 202055 202055 202055
HONIG, R (RADIO CORP OF AM LABS PRINCETON N J) VAPOR PRESSURE DATA FOR THE SOLID AND LIQUID ELEMENTS R C A REV 23, 81 (1962) BHT 7, 7 (1963)	301144 301144 301144 301144 301144
HONIG, R HOOK, H VAPOR PRESSURE DATA FOR SOME COMMON CASES RCA REV 21 360 (1960) CA 55, 5066 (1961)	300424 300424 300424 300424
HOOD, C THURSTON, M FLOATING ZONE REFINING OF BORON USING ELECTRON BEAM MELTING J ELECTROCHEM SOC 109, 66 (1962)	601694 601694 601694
HOOVER, E KEEN, N THE PURIFICATION OF BE METAL BY A DISTILLATION PROCESS AT ENERGY RESEARCH ESTABL (GT BRIT) R-3321, (1960) CA 55, 10248 (1961)	200947 200947 200947 200947
HOPKINS, B WORK FUNCTION OF URANIUM CARBIDE NATURE 193, NO 4816, 668 (1962) REV METAL LIT 19, 28 (1962) BHT NO 2, 7 (1962) PA 65, 11685 (1962)	300516 300516 300516 300516 300516 300516
HOPKINS, B ROSS, K THE WORK FUNCTION OF ZIRCONIUM CARBIDE PROC PHYS SOC (LONDON) 79, NO 508, 447 (1962)	300515 300515 300515

BHT NO 2, 7 (1962)	300515
PA 65, 7637 (1962)	300515
HOPKINS, M	601171
(UNIV COLL. SWANSEA ENGLAND)	601171
THERMAL AND ELECTRICAL CONDUCTIVITIES OF METALS AT HIGH	601171
TEMPERATURES	601171
Z PHYSIK 147, NO 2, 148 (1957)	601171
CA 54, 19141 (1960)	601171
HORI, J	301478
(ELEC COMMUN LAB TOKYO JAPAN)	301478
ELECTROLUMINESCENCE IN SIC SINGLE CRYSTALS	301478
JAPAN J APPL PHYS 1, 262 (1962)	301478
CA 58, 2951 (1963)	301478
HORN, F	700969
(GE RESEARCH LAB SCHENECTADY NY)	700969
SIMPLE RHOMBHEDRAL BORON-PREPARATION AND PROPERTIES	700969
NSA 15, 7837 (1961)	700969
HORN, F	601213
THE CRYSTALLIZATION OF SIMPLE RHOMBHEDRAL BORON FROM	601213
PLATINUM	601213
J ELECTROCHEM SOC 106, 905 (1959)	601213
CA 54, 204 (1960)	601213
HORTON, J THOMAS, J WARREN, V	201851
(UNION CARBIDE NUCL CO OAK RIDGE TENN)	201851
MASS-SPECTROMETER DETERMINATION OF THE MÖYBDENUM-URANIUM	201851
RATIOS IN THE MIXTURES OF THE HEXAFLUORIDES	201851
US AT ENERGY COMM K1433, (1962)	201851
CA 57, 11956 (1962)	201851
HUCK, J	701003
(BATTELLE MEM INST COLUMBUS OHIO)	701003
PHYSICAL AND MECHANICAL PROPERTIES OF COMMERCIAL	701003
MÖLYBDENUM-BASE ALLOYS	701003
DEFENSE METALS INFORMATION CENTER COLUMBUS, OHIO DMIC-140	701003
NSA 15, 9405 (1961)	701003
HUGEN, J	301479
(NATL RES COUNCIL OTTAWA CANADA)	301479
CLASSIFICATION OF ROTATION ENERGY LEVELS FOR SYMMETRIC-TOP	301479
MÖLECULES	301479
J CHEM PHYS 37, 1433 (1962)	301479
CA 58, 929 (1963)	301479
HUGEN, J	300781
VIBRONIC AND ROTATIONAL ENERGY LEVELS OF A LINEAR	300781
TRIATOMIC MÖLECULE IN A 3-PI ELECTRONIC STATE	300781
J CHEM PHYS 36, 1874 (1962)	300781
PA 65, 12319 (1962)	300781
HUGEN, J	300784
THE ROTATIONAL ENERGY LEVELS OF DIATOMIC MÖLECULES IN	300784
4-SIGMA ELECTRONIC STATES	300784
CANAD J PHYS 40, 598 (1962)	300784
PA 65, 12317 (1962)	300784
HÖVE, J	601303
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	601303
SOLID STATE PHYSICS SEMI ANNUAL PROGRESS	601303

REPT FOR JULY-DEC 1956		601303
NAA-SR-1895		601303
NSA 11, 8942 (1957)		601303
HØVIS, W		300824
(THE JOHN HØPKINS UNIV BALTIMØRE MD)		300824
TIME RESØLVED SPECTRA ØF RARE-EARTH IØNS		300824
J ØPT SØC AM 52, 649 (1962)		300824
HØWELL, H		600712
DISSØCIATION ENERGY ØF CARBØN MØNØXIDE		600712
NATURE 163, 773 (1949)		600712
PA 52, 5602 (1949)		600712
HØWLETT, B		601357
(MIT CAMBRIDGE MASS)		601357
A NØTE ØN THE URANIUM-BØRØN ALLØY SYSTEMS		601357
J INST MET 88, 91 (1959)		601357
NSA 14, 6701 (1960)		601357
HØYT, E CHØRNE, J CUMMINGS, W		300246
(VALLECITOS ATØMIC LAB GE PLEASANTØWN CALIFØRNIA)		300246
CØRRØSION BEHAVIØR ØF SØME METAL BØRIDES		300246
TECH REPT, 17 (1960) 11786 GEAP-3548		300246
US GØVT PUB (1961)		300246
HUBER, E		601316
(LØS ALAMØS SCI LAB LØS ALAMØS N MEXICØ)		601316
THE HEAT ØF CØMBUSTIØN ØF Y		601316
J PHYS CHEM 61, 497 (1957)		601316
NSA 11, 6757 (1957)		601316
HUBER, E		601291
(LØS ALAMØS SCI LAB LØS ALAMØS N MEXICØ)		601291
THE HEATS ØF CØMBUSTIØN ØF DY AND YB		601291
J PHYS CHEM 60, 1457 (1956)		601291
NSA 11, 973 (1957)		601291
HUBER, E FITZGIBBØN, G HEAD, E HØLLEY, C		202057
THE HEAT ØF FØRMATION ØF SCANDIUM ØXIDE		202057
J PHYS CHEM 67 (8), 1731 (1963)		202057
CA 59, 8189 (1963)		202057
HUBER, E HEAD, E HØLLEY, C		601272
(LØS ALAMØS SCI LAB LØS ALAMØS NEW MEXICØ)		601272
THE HEAT ØF CØMBUSTIØN ØF SAMARIUM		601272
J AM CHEM SØC 77, 6493 (1955)		601272
NSA 10, 2657 (1956)		601272
HUBER, E HEAD, E HØLLEY, C		601041
(LØS ALAMØS SCI LAB LØS ALAMØS NEW MEXICØ)		601041
THE HEATS ØF CØMBUSTIØN ØF DYSPRØSIUM AND YTTERBIUM		601041
J PHYS CHEM 60, 1457 (1956)		601041
CA 51, 4120 (1957)		601041
HUBER, E HEAD, E HØLLEY, C		700842
THE HEAT ØF CØMBUSTIØN ØF YTTRIUM		700842
J PHYS CHEM 61, 497 (1957)		700842
CA 51, 11836 (1957)		700842
HUBER, E HEAD, E HØLLEY, C		202056
(LØS ALAMØS SCI LAB LØS ALAMØS NEW MEXICØ)		202056
THE HEAT ØF FØRMATION ØF UARNIUM DICARBIDE		202056

J PHYS CHEM 67 (8), 1730 (1963)	202056
CA 59, 8189 (1963)	202056
HUBER JR, E J HEAD, E L HÖLLEY JR, C E HOWMAN, A L	301248
THE HEATS OF FORMATION OF TANTALUM CARBIDES	301248
J PHYS CHEM 67, 793 (1963)	301248
CA 58, 10794F (1963)	301248
HUBER, E HEAD, E HÖLLEY, C STØRMS, E KRIKØRIAN, N	201192
(LOS ALAMOS SCI LAB LOS ALAMOS N MEX)	201192
HEATS OF COMBUSTION OF NIOBIUM CARBIDES	201192
J PHYS CHEM 65, 1846 (1961)	201192
CA 56, 74 (1962)	201192
NSA 15, 16068 (1961)	201192
HUBER, E HÖLLEY, C	100213
(U. OF CALIFORNIA LOS ALAMOS N.M.)	100213
THE HEAT OF COMBUSTION OF NEODYMIUM	100213
J AM CHEM SOC 74, 5530 (1952)	100213
CA 47, 10986 (1953)	100213
HUBER, E HÖLLEY, C	600930
(U. OF CALIFORNIA LOS ALAMOS N.M.)	600930
THE HEAT OF COMBUSTION OF GADOLINIUM	600930
J AM CHEM SOC 77, 1444 (1955)	600930
CA 49, 9376 (1955)	600930
HUBER, E HÖLLEY, C	700900
(U. OF CALIFORNIA LOS ALAMOS N.M.)	700900
THE HEAT OF COMBUSTION OF LANTHANUM	700900
J AM CHEM SOC 75, 3594 (1953)	700900
CA 48, 1131 (1954)	700900
HUBER, E HÖLLEY, C	600963
(U. OF CALIFORNIA LOS ALAMOS N.M.)	600963
HEAT OF COMBUSTION OF CERIUM	600963
J AM CHEM SOC 75, 5645 (1953)	600963
CA 48, 3134 (1954)	600963
NSA 8, 773 (1954)	600963
HUBER JR, E J FITZGIBBON, J C HEAD, E L HÖLLEY JR, C L	301246
THE HEAT OF FORMATION OF SCANDIUM OXIDE	301246
J PHYS CHEM 67, 1731 (1963)	301246
HUBER JR, E J HEAD, E L HÖLLEY JR, C E	301247
THE HEAT FORMATION OF URANIUM DICARBIDE	301247
J PHYS CHEM 67, 1730 (1963)	301247
HUBER, E HÖLLEY, C MEIERKØRD, E	400565
THE HEATS OF COMBUSTION OF THORIUM AND URANIUM	400565
J AM CHEM SOC 74, 3406 (1952)	400565
CA 46, 10841 (1952)	400565
HUBER, E HÖLLEY, C ED BY SKINNER, H	700704
EXPERIMENTAL THERMOCHEMISTRY VOL II	700704
INTERSCIENCE NY (1962)	700704
HUBER, E MATTHEWS, C HÖLLEY, C	601008
(LOS ALAMOS SCI LAB LOS ALAMOS NM)	601008
HEAT OF COMBUSTION OF SAMARIUM	601008
J AM CHEM SOC 77, 6493 (1955)	601008
CA 50, 6172 (1956)	601008

HUGHES, R KENNARD, C SULLENGER, D WEAKHEIM, H SANDS, D	300901
HØARD, J	300901
STRUCTURE OF BETA-RHOMBØHEDRAL BØRØN	300901
J AM CHEM SØC 85, 361 (1963)	300901
HULDT, L LAGERQVIST, A	600893
TERM SCHEMES OF CAØ, SRØ AND BAØ	600893
ARK FYS 9, 227 (1955)	600893
PA 58, 3567 (1955)	600893
HULDT, L LAGERQVIST, A	600894
THE ØRIGIN OF THE BAND SPECTRA OF CALCIUM AND STRØNTIUM	600894
ARKIV FYSIK 11, 347 (1956)	600894
CA 51, 7850 (1957)	600894
HULDT, L LAGERQVIST, A	600764
DETERMINATION OF DISSØCIATION ENERGIES OF DIATØMIC	600764
MØLECULES FROM SPECTRØSCØPIC INTENSITY MEASUREMENTS	600764
THE DISSØCIATION ENERGIES OF CHRØMIUM ØXIDE AND MANGANESE	600764
ØXIDE	600764
ARKIV FYSIK 3, 525 (1952)	600764
CA 47, 931 (1953)	600764
HULM, J BLAUGHER, R GEBALLE, T MATTHIAS, B	201421
(WESTINGHOUSE RES LABS PITTSBURGH PA)	201421
SUPERCONDUCTIVITY OF NIØBIUM-MØLYBDENUM ALLØYS BELOW	201421
1 DEGREES K	201421
PHYS REV LETTERS 7, 302 (1961)	201421
CA 56, 9562 (1962)	201421
HUME-RØTHERY, W	202059
ATØMIC THEORY FOR STUDENTS OF METALLURGY	202059
INSTITUTE OF METALS (1962)	202059
HULTIN, M LAGERQVIST, A	600898
AN INFRARED BAND SYSTEM OF CALCIUM ØXIDE	600898
ARKIV FYSIK 2, 471 (1951)	600898
CA 45, 6928 (1951)	600898
HUME-RØTHERY, W	301249
NØTE ON A STATISTICAL APPROACH TO EQUILIBRIUM DIAGRAM	301249
TRANS MET SØC AIME 227, 791A (1963)	301249
HUNT, E RUNDLE, R	400573
THE STRUCTURE OF THØRIUM DICARBIDE BY X-RAY AND NEUTRØN	400573
DIFFRACTION	400573
J AM CHEM SØC 73, 4777 (1951)	400573
AECD 3021 (1950)	400573
CA 46, 4311 (1952)	400573
NSA 5, 1807 (1951)	400573
HURLEN, T	301250
ØXIDATION OF NIØBIUM	301250
INST HIERRØ Y ACERØ 13, 714 (1960)	301250
CA 55, 3263H (1961)	301250
HURLEN, T	700542
ØXIDATION OF NIØBIUM	700542
J INST METALS 89, 273 (1960)	700542
NSA 15, 19786 (1961)	700542
HURLEN, T	200890
ØXIDATION OF TITANIUM	200890

J INST METALS 89, 128 (1960)	200890
CA 55, 6318 (1961)	200890
HURLEN, T KJØELLES DAL, H MARKALI, J NØRMAN, N	201306
(CENTRAL INST IND RESEARCH ØSLØ NØRWAY)	201306
OXIDATION OF NIØBIUM	201306
U S DEPT COM OFFICE TECH SERV, PB REPT 145-171, (1959)	201306
CA 56, 4357 (1962)	201306
IANDELLI, A	601275
ON THE CRYSTALLINE STRUCTURE OF COMPOUNDS OF	601275
RARE AND METALLOIDS OF GROUP V AND COMPOUNDS	601275
ATTI ACCAD LINCEI CLASSE SCI FIS MAT NAT 25, 638 (1938)	601275
AEC-TR-2170	601275
NSA 9, 5294 (1955)	601275
IANDELLI, A	601276
ON THE CRYSTALLINE STRUCTURE OF COMPOUNDS OF RARE EARTHS	601276
AND METALLOIDS OF GROUP V NITRIDES OF LA, CE AND PR	601276
ATTI ACCAD LINCEI CLASSE SCI FIS MAT NAT 25, 129 (1937)	601276
AEC-TR-2168	601276
NSA 9, 5292 (1955)	601276
IANDELLI, A	700897
MODIFICATIONS OF SESQUIOXIDES OF THE RARE EARTHS	700897
GAZZ CHIM ITAL 77, 312 (1947)	700897
CA 42, 2833 (1948)	700897
IANNIELLO, L	201146
(R P I TRØY NY)	201146
EFFECT OF RARE EARTH ELEMENTS ON THE ALPHA-BETA	201146
TRANSFORMATION OF ZR	201146
UNIV MICROFILM (ANN ARBOR MICH) L C CARD NO MIC 61-982	201146
DISSERTATION ABSTR 22, 217 (1961)	201146
CA 55, 20853 (1961)	201146
IBRAHIM, M BRIGHT, N	201638
(DEPT MINES AND TECH SURVEYS OTTAWA CANADA)	201638
THE BINARY SYSTEM, Nb ₂ O ₅ -SiO ₂	201638
J AM CERAM SOC 45, 221 (1962)	201638
CA 57, 4094 (1962)	201638
IBRAHIM, M BRIGHT, N ROWLAND, J	201876
(DEPT OF MINES AND TECH SURV OTTAWA CANADA)	201876
BINARY SYSTEMS CaO-Nb ₂ O ₅	201876
J AM CERAM SOC 45, 329 (1962)	201876
CA 57, 13219 (1962)	201876
ICZKOWSKI, R MARGRAVE, J ROBINSON, S	300905
EFFUSION OF GASES THROUGH CONICAL ORIFICES	300905
J PHYS CHEM 67, 229 (1963)	300905
IGNATOV, D LEBEDEV, Y	301041
UNIVERSAL APPARATUS FOR DETERMINING EVAPORATION AND	301041
DECOMPOSITION RATES OF VARIOUS SUBSTANCES IN A VACUUM	301041
FIZ-KHIM OSNOVY PROIZV STALI AKAD NAUK-SSSR INST MET	301041
FIFTH CONF 1959, 305 (1961)	301041
CA 5052 (1963)	301041
IIDA, Y ØZAKI, S	700519
GRAIN GROWTH AND PHASE TRANSFORMATION OF TITANIUM OXIDE DURING	700519
CALCINATION	700519

J AM CERAM SOC 44, 120 (1961)	700519
INGHRAM, M	300303
THERMODYNAMICS OF REFRACTORY MATERIALS AS DETERMINED WITH	300303
A MASS SPECTROMETER	300303
AD 248619 FINAL REPT (1960)	300303
INGHRAM, M CHUPKA, W BERKOWITZ, J	601067
(UNIV CHICAGO CHICAGO ILL)	601067
DISSOCIATION ENERGIES FROM THERMODYNAMIC EQUILIBRIA	601067
STUDIED WITH A MASS SPECTROMETER	601067
MEM SOC ROY SCI LIEGE 18, 513 (1957)	601067
CA 51, 16085 (1957)	601067
INGOLD, J H	301251
(GEN ELEC CO PLEASANTON CALIF)	301251
THERMIONIC PROPERTIES OF SOME REFRACTORY METAL CARBIDES	301251
J APPL PHYS 34, (7), 2033 (1963)	301251
CA 59, 2254F (1963)	301251
IOFFE, V BAGAEVA, V PEDYASH, L	200837
PRODUCTION OF ALLOYS OF AL-CE, AL-LA, MG-CE, MG-LA,	200837
AND MG-ND BY ELECTROLYSIS	200837
REDKIE METALLY I SPLAVY, TRUDY PERVOGO VSESUYUZ SOVE-	200837
SHCHANIYA PO SPLAVAM REDKIKH METAL, AKAD NAUK SSSR	200837
INST MET IM AA BAIKOVA, MOSCOW 1957, 180 (1960)	200837
CA 55, 3387 (1961)	200837
IONOV, N MITTSEV, M	601180
(PHYS-TECH INST ACAD SCI LENINGRAD USSR)	601180
DETERMINATION OF FIRST IONIZATION POTENTIALS OF NEODYMIUM	601180
AND PRASEODYMIUM ATOMS BY THE METHOD OF SURFACE IONIZATION	601180
ZHUR EKSPTL I TEORET FIZ 38, 1350 (1960)	601180
CA 54, 14954 (1960)	601180
IONOV, N MITTSEV, M	601411
(LENINGRAD INST OF PHYSICS LENINGRAD RUSSIA)	601411
DETERMINATION OF THE FIRST IONIZATION POTENTIALS	601411
OF ATOMS BY THE SURFACE IONIZATION TECHNIQUE	601411
ZHUR EKSPTL I TEORET FIZ 40, 741 (1961)	601411
NSA 15, 20025 (1961)	601411
IONOV, N MITTSEV, M	601332
(LENINGRAD INST OF PHYS AND TECH)	601332
DETERMINATION OF THE INITIAL IONIZATION POTENTIALS	601332
OF NEODYMIUM AND PRASEODYMIUM ATOMS	601332
ZHUR EKSPTL I TEORET FIZ 38, 1350 (1960)	601332
NSA 14, 21479 (1960)	601332
ISUPOVA, E KELER, E	201573
REACTIONS IN THE SYSTEM BeO-SiO2	201573
ZH NEORGAN KHIM 5, 1126 (1960)	201573
CA 57, 369 (1962)	201573
IVANOV, V KRUGLYKH, A PAVLOV, V KOVJUN, G AMONENKO, V	601604
DETERMINATION OF VAPOR PRESSURE OF URANIUM COMPOUNDS	601604
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR	601604
MATERIALS, PROCEEDINGS, VIENNA (1962)	601604
COTS 55, 204 (1962)	601604
NSA 16, 25371 (1962)	601604
IVANOV, O TEREHKOV, G	201832
ISOTHERMAL SECTIONS AT 500 AND 560 DEGREES AND PHASE DIAGRAM	201832

OF THE URANIUM-NIØBIUM-MØLYBDENUM TERNARY SYSTEM	201832
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH	201832
SISTEM S URANØM I TØRIEM) 1961, 214 (1961)	201832
CA 57, 10882 (1962)	201832
IVANØV, Ø TEREKHØV, G	201840
ISØTHERMAL SECTIONS AT 550, 575, AND 600 DEGREES, PØLYTHERMAL	201840
SECTIONS, AND CØSTITUTIONAL DIAGRAM ØF ØF THE TERNARY	201840
URANIUM-MØLYBDENUM-ZIRCØNIUM SYSTEM	201840
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH	201840
SISTEM S URANØM I TØRIEM) 1961, 166 (1961)	201840
CA 57, 11907 (1962)	201840
IVANØV, Ø TEREKHØV, G	201841
PØLYTHERMAL CRØSS-SECTION ØF THE CØSTITUTIONAL DIAGRAM ØF	201841
THE URANIUM-NIØBIUM-MØLYBDENUM SYSTEM	201841
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM	201841
S URANØM I TØRIEM) 1961, 199 (1961)	201841
CA 57, 11908 (1962)	201841
IVANØV, Ø TEREKHØV, G	201842
ISØTHERMAL SECTIONS AT 575-1200 DEGREES AND CØSTITUTIONAL	201842
DIAGRAM ØF THE URANIUM-NIØBIUM-MØLYBDENUM SYSTEM	201842
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM	201842
S URANØM I TØRIEM) 1961, 228 (1961)	201842
CA 57, 11908 (1962)	201842
IVANØV, Ø BADAËVA, T SEMENCHENKØV, A KUZNETSØVA, R	201868
THE URANIUM-MØLYBDENUM SYSTEM AT 600-1200 DEGREES AND	201868
PRØPERTIES ØF ITS ALLØYS	201868
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM	201868
S URANØM I TØRIEM) 1961, 48 (1961)	201868
CA 57, 12230 (1962)	201868
IVANØV, Ø ALEKSEEVA, Z	201875
THE SYSTEM THØRIUM-URANIUM MØNØCARBIDE	201875
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH	201875
SISTEM S URANØM I TØRIEM) 1961, 428 (1961)	201875
CA 57, 13219 (1962)	201875
IVANØV, Ø GØMØZØV, L	201895
PHASE DIAGRAM ØF URANIUM-ZIRCØNIUM-NIØBIUM SECTIONS WITH A	201895
CØNSTANT URANIUM CØNTENT AND THE PØLYTHERMAL DIAGRAM ØF THE	201895
SYSTEM	201895
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH SISTEM	201895
S URANØM I TØRIEM) 1961, 107 (1961)	201895
CA 57, 13503 (1962)	201895
IVANØV, Ø SEMENCHENKØV, A KØZLØVA, N	201896
STRUCTURE ØF THE ALLØYS ØF THE URANIUM-MØLYBDENUM SYSTEM	201896
BELOW 600 DEGREES AND THE PHASE DIAGRAM ØF THIS SYSTEM	201896
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH	201896
SISTEM S URANØM I TØRIEM) 1961, 68 (1961)	201896
CA 57, 13504 (1962)	201896
IVANØV, Ø BAGRØV, G	201898
ISØTHERMAL SECTIONS ØF THE URANIUM-MØLYBDENUM-ZIRCØNIUM	201898
SYSTEM AT 625-1000 DEGREES	201898
TR INST MET IM A A BAIKØVA (STRØENIE SPLAVØV NEKØTØRYKH	201898
SISTEM S URANØM I TØRIEM) 1961, 141 (1961)	201898
CA 57, 13504 (1962)	201898
IVANØV, Ø TEREKHØV, G	201945

STRUCTURAL DIAGRAM AND CONSTITUTION OF THE ALLOYS IN THE SYSTEM URANIUM-NIOBIUM	201945
TR INST MET IM A A BAIKOVA (STRONIE SPLAVOV NEKOTORYKH SISTEM S URANOM I TORIEM) 1961, 20 (1961)	201945
CA 57, 16270 (1962)	201945
IVANOVA, L	201347
CALCULATION OF THE HIGH TEMPERATURE HEAT CAPACITIES OF SOLID SUBSTANCES	201347
IZVEST VYSSHIKH UCHEB ZAVEDENII, TSVETNAYA MET 4, 45 (1961)	201347
CA 56, 6726 (1962)	201347
IVERONOVA, V ZOYAGINA, A	202061
(MOSCOW STATE UNIV MOSCOW RUSSIA)	202061
PHONON SPECTRUM AND SOME THERMODYNAMIC CHARACTERISTICS OF CS CL TYPE LATTICES	202061
UKR FIZ ZH 8, 238 (1963)	202061
CA 59, 1147 (1963)	202061
IWA1, S YASUNAGA, A	700684
THERMAL EXPANSION OF SILICON NITRIDE, Si3N4	700684
NATURWISSENSCHAFTEN 46, 473 (1959)	700684
CE 44, 199 (1961)	700684
JACOB, C WARREN, B	601653
THE CRYSTAL STRUCTURE OF URANIUM	601653
J AM CHEM SOC 59, 2588 (1937)	601653
JACOB, J	600808
INFRARED SPECTROSCOPIC DETERMINATION OF THE EQUILIBRIUM CONSTANTS BETWEEN MONOMERIC AND DIMERIC FORMS OF GASEOUS NITROGEN PEROXIDE AND RANGE OF VALIDITY OF THE METHOD	600808
J CHIM PHYS 56, 296 (1959)	600808
CA 55, 16142 (1961)	600808
JACOBSON, R	601148
CRYSTAL AND MOLECULAR STRUCTURE OF B8C8	601148
DISSERTATION ABS. 20, 114 (1959)	601148
MIC 59-2356, 653 (1959)	601148
CA 53, 18586 (1959)	601148
JAEGER, F	900127
ADDITIVITY LAW FOR SPECIFIC HEATS OF HETEROPOLAR COMPOUNDS	900127
CHEM WEEKBLAD 31, 60 (1934)	900127
JAEGER, F	900139
THE DEPENDENCE OF SPECIFIC HEAT ON TEMPERATURE IN THE ELEMENTS OF THE EIGHTH GROUP OF THE PERIODIC SYSTEM	900139
Z ANORG ALLGEM CHEM 203, 97 (1931)	900139
CA 26, 1486 (1932)	900139
JAEGER, F BOTTEMA, J ROSENBOHM, E	900102
THE EXACT MEASUREMENT OF THE SPECIFIC HEATS OF METALS AT HIGH TEMPERATURES. XXVI. THE SPECIFIC HEATS AND ELECTRICAL RESISTANCE OF CERIUM	900102
WETENSCHAP 39, 912 (1936)	900102
CA 31, 938 (1937)	900102
JAEGER, F ROSENBOHM, E	700505
THE EXACT MEASUREMENT OF THE SPECIFIC HEATS OF SOLID SUBSTANCES AT HIGH TEMPERATURES. III. THE SPECIFIC HEATS OF PALLADIUM AND OF TUNGSTEN	700505
	700505
	700505

PROC ACAD SCI AMSTERDAM 33, 457 (1930)	700505
CA 24, 4678 (1930)	700505
JAEGER, F RØSENBOHM, E	700506
ON THE ACCURATE MEASUREMENT OF THE SPECIFIC HEAT OF SOLID	700506
SUBSTANCES BETWEEN 0 DEGREES AND 1625 DEGREES C. II. THE	700506
SPECIFIC HEAT OF PLATINUM AND TUNGSTEN	700506
PROC ACAD SCI AMSTERDAM 30, 1069 (1927)	700506
CA 22, 1087 (1928)	700506
JAFFEE, H ZUNG, V	301480
IMPROVED METHODS FOR CALCULATION OF BOND ENERGIES	301480
AD 271472	301480
JAFFEE, R MAYKUTH, D DUGLASS, R	201285
(BATTELLE MEM INST COLUMBUS OHIO)	201285
RHENIUM AND THE REFRACTORY PLATINUM-GROUP METALS	201285
MET SOC CONF 11, 357 (1960)	201285
CA 56, 3246 (1962)	201285
JAFFRAY, J	700655
THE INVESTIGATION OF HIGHER ORDER TRANSFORMATIONS BY THERMAL	700655
ANALYSIS	700655
JUR DES RECHERCHES DU CENTRE NATIONAL DE LA RECHERCHE	700655
SCIENTIFIQUE 153 (1947)	700655
GR 36 NO 1, 111 (1961)	700655
JAGODZINSKI, H ARNOLD, H	200898
ANOMALOUS SILICON CARBIDE STRUCTURES	200898
SILICON CARBIDE, PROC CONF, BOSTON 1959, 136 (1960)	200898
CA 55, 6977 (1961)	200898
JAMES, T C	301481
(GEN DYNAMICS ASTRONAUTICS SAN DIEGO CALIF)	301481
INTENSITY DISTRIBUTION IN THE FORBIDDEN 1E-3112 TRANSITION	301481
OF SiO	301481
J CHEM PHYS 38, 1094 (1963)	301481
CA 58, 7497 (1963)	301481
JAMES, T C	301252
INTENSITY DISTRIBUTION IN THE FORBIDDEN 1E-3112 TRANSITION	301252
J CHEM PHYS 38, 1094 (1963)	301252
CA 58, 7497 (1963)	301252
JAMES, N LEGVOLD, S SPEDDING, F	100206
THE RESISTIVITY OF LA, CF, PR AND ND AT LOW TEMPERATURES	100206
PHYS REV 88, 1092 (1952)	100206
US ATOMIC ENERGY COMM I S C 229, 54 (1952)	100206
CA 47, 3071 (1953)	100206
CA 50, 3022 (1956)	100206
JAMES, W	201196
(UNIV OF MISSOURI ROLLA MISSOURI)	201196
LATTICE PARAMETER AND COEFFICIENT OF THERMAL EXPANSION	201196
OF VANADIUM	201196
Z PHYSIK, CHEM 29, 134 (1961)	201196
CA 56, 84 (1962)	201196
JANIN, J	600587
CERTAIN SINGLET SYSTEMS OF THE NITROGEN MOLECULE	600587
J RECHERCHES CENTRE NATL RECHERCHE SCI NO 12, 156 (1950)	600587
CA 44, 10509 (1950)	600587

JAMIESON, J			202062
(UNIV OF CHICAGO	CHICAGO	ILL)	202062
CRYSTAL STRUCTURES AT HIGH PRESSURES OF METALLIC			202062
MODIFICATIONS OF SILICON AND GERMANIUM			202062
SCIENCE 139, 762 (1963)			202062
CA 58, 9928 (1963)			202062
JAMIESON, J C			301253
(UNIV OF CHICAGO	CHICAGO	ILL)	301253
CRYSTAL STRUCTURES OF TITANIUM, ZIRCONIUM AND HAFNIUM AT HIGH			301253
PRESSURES			301253
SCIENCE 140, 72 (1963)			301253
CA 59, 2238H (1963)			301253
JANNINCK, F			301255
(NORTHWESTERN UNIV	EVANSTON	ILL)	301255
THE ELECTRICAL CONDUCTIVITY OF A-NB2O5 AND NB2O4			301255
UNIV MICROFILMS ORDER NO 63-1304, 114			301255
DISSERTATION ABSTR 23, 3304 (1963)			301255
CA 59, 2248E (1963)			301255
JAYARAMAN, A KLEMENT JR, W KENNEDY, G			301482
(UNIV OF CALIFORNIA	LOS ANGELES	CALIF)	301482
SOLID-SOLID TRANSITIONS IN TITANIUM AND ZIRCONIUM AT HIGH			301482
PRESSURES			301482
PHYS REV 131 (2), 644 (1963)			301482
CA 59, 3410 (3411) (1963)			301482
JEANNIN, Y MANNERSKANTZ, C RICHARDSON, F			301483
(IMP COLL SCI TECHNOL	LONDON	ENGLAND)	301483
ACTIVITIES IN IRON-CHROMIUM ALLOYS			301483
TRANS AIME 227, 300 (1963)			301483
CA 58, 13516 (1963)			301483
JEITSCHKO, W NOWOTNY, H BENESOVSKY, F			301486
(UNIV VIENNA	VIENNA	AUSTRIA)	301486
THE TERNARY SYSTEM MOLYBDENUM-ALUMINUM-CARBON			301486
THE PHASE M03AL2C			301486
MONATSH 94, 247 (1963)			301486
CA 58, 12248 (1963)			301486
JEITSCHKO, W NOWOTNY, H BENESOVSKY, F			301485
(UNIV VIENNA	VIENNA	AUSTRIA)	301485
CARBON-CONTAINING TERNARY PHASES			301485
MONATSH 94, 332 (1963)			301485
CA 58, 12248 (1963)			301485
JEITSCHKO, W NOWOTNY, H			301484
(UNIV VIENNA	VIENNA	AUSTRIA)	301484
THE STRUCTURE OF HFP			301484
MONATSH 93, 1107 (1962)			301484
CA 58, 2918 (1963)			301484
JENCKEL, L			300322
USE OF THE MASS SPECTROMETER TO MEASURE THE PARTIAL			300322
PRESSURES OF SYSTEMS UNDER VACUUM			300322
VIDE 16, 176 (1961)			300322
BHT 4, 5 (1961)			300322
JENNINGS, L HILL, E SPEDDING, F			601197
(IOWA STATE COLL	AMES	IOWA)	601197
HEAT CAPACITY OF SAMARIUM FROM 13 TO 350 DEG K			601197
J CHEM PHYS 31, 1240 (1959)			601197

CA 54, 6287 (1960)	601197
NSA 14, 3812 (1960)	601197
JENNINGS, L MILLER, R SPEDDING, F	201049
(IOWA STATE UNIV AMES IOWA)	201049
LATTICE HEAT CAPACITY OF THE RARE EARTHS. HEAT CAPACITIES	201049
OF YTTRIUM AND LUTETIUM FROM 15 TO 350 DEGREES K	201049
J CHEM PHYS 33, 1849 (1960)	201049
CA 55, 16113 (1961)	201049
NSA 15, 9466 (1961)	201049
JERE, G PATEL, C	201036
(INDIAN INST SCI BANGALORE INDIA)	201036
THERMODYNAMICS OF CHLORINATION OF TITANIUM MINERALS	201036
J MINES, METALS AND FUELS 8, NO 7, 133 (1960)	201036
CA 55, 14223 (1961)	201036
JENSEN, A V GOSHGARIAN, B B DANE, N E	301256
(AIR FORCE SYSTEMS COMMAND INGLEWOOD CALIF)	301256
MASS SPECTRAL ANALYSIS OF ROCKET ENGINE COMBUSTION PRODUCTS	301256
CONTAINING BORON NITRIDE	301256
AD 295656	301256
TAB 63-2-3, 74 (1963)	301256
JENSOVSKY, L	301487
(INST ARBEITSHG BERUFSKRANKHEITEN PRAGUE)	301487
BADGERS RULE	301487
Z CHEM 2, 334 (1962)	301487
CA 58, 7386 (1963)	301487
JERE, G PATEL, C	200850
STANDARD FREE ENERGY OF FORMATION OF NBCL ₅ (G) AND	200850
TACL ₅ (G)	200850
J SCI AND IND RESEARCH 198, 315 (1960)	200850
CA 54, 4136 (1961)	200850
JØHANSEN, H CLEARY, J	201882
(WESTINGHOUSE CORP PITTSBURGH PA)	201882
HIGH TEMPERATURE ELECTRICAL CONDUCTION IN THE	201882
SYSTEM UO ₂ -ZRO ₂	201882
J ELECTROCHEM SOC 109, 1076 (1962)	201882
CA 57, 13258 (1962)	201882
JØHANSSON, L	601624
(UNIV LUND SWEDEN)	601624
THE SPECTRUM OF IONIZED BERYLLIUM	601624
ARKIV FYSIK 20, 489 (1962)	601624
NSA 16, 24292 (1962)	601624
CA 56, 11078 (1962)	601624
JOHNS, I TUCKER, W FIGARD, P	601375
THE SYSTEM URANIUM-NITROGEN	601375
AECD 2247, NO (1948)	601375
NSA 1, 1224 (1948)	601375
JOHNS, J	300816
THE ABSORPTION SPECTRUM OF B02	300816
CANAD J PHYS 39, NO 12, 1738 (1961)	300816
PA 65, NO 2004, (1962)	300816
JØHNSØN, O TEMPLETON, D	700881
(UNIV OF CALIFORNIA BERKELEY CAL)	700881
MADELUNG CONSTANTS FOR SEVERAL STRUCTURES	700881

J CHEM PHYS 34, 2004 (1961)	700881
NSA 15, 22771 (1961)	700881
JOHNSON, R	201253
(UNIV SHEFFIELD SHEFFIELD ENGLAND)	201253
THE SOLID SOLUBILITY OF ZIRCONIUM IN ALPHA-THORIUM	201253
J NUCLEAR MATERIALS 4, 59 (1961)	201253
CA 56, 2054 (1962)	201253
JOHNSON, R DAANE, A	201106
(IOWA STATE UNIV AMES IOWA)	201106
THE LANTHANUM-BORON SYSTEM	201106
J PHYS CHEM 65, 909 (1961)	201106
CA 55, 18273 (1961)	201106
JOHNSON, R HUDSON, D	601224
MASS SPECTROMETRIC DETERMINATION OF LATENT HEATS OF METALS	601224
CONTRACT W-7405-ENG-82 ISC-293 (1952)	601224
NSA 8, 2848 (1954)	601224
JOHNSON, R	301488
(GENERAL DYNAMICS FORT WORTH TEXAS)	301488
CURRENT INFORMATION ON THE REFRACTORY METALS	301488
REPT NO ERR-FW-049	301488
CONTRACT AF 33, (657) 7248	301488
AD 273624-NOT AVAILABLE FOR REPRODUCTION	301488
JOHNSON, R DAANE, A	301489
(IOWA STATE UNIV AMES IOWA)	301489
ELECTRON REQUIREMENTS OF BONDS IN METAL BORIDES	301489
J CHEM PHYS 38, 425 (1963)	301489
CA 58, 3895 (1963)	301489
JOHNSON, R HUDSON, D CALDWELL, W SPEDDING, F SAVAGE, W	601040
(IOWA STATE COLLEGE AMES IOWA)	601040
MASS SPECTROMETRIC STUDY OF PHASE CHANGES IN AL, PR AND ND	601040
J CHEM PHYS 25, 917 (1956)	601040
NSA 11, 1471 (1957)	601040
CA 51, 4119 (1957)	601040
JOHNSON, V	300908
PROPERTIES OF MATERIALS AT LOW TEMPERATURES (PHASE I)	300908
PERGAMON PRESS NY (1961)	300908
JOHNSON, W GILLILAND, A	200976
HEAT OF FORMATION OF BERYLLIUM CHLORIDE	200976
J RESEARCH NATL BUR STANDARDS 65A, 59 (1961)	200976
CA 55, 12020 (1961)	200976
JONES, G	301490
(CLARKSON COLL TECH POTSDAM NY)	301490
UNIFIED QUANTITATIVE INTERPRETATION OF TWO-COMPONENT PHASE	301490
DIAGRAMS	301490
J CHEM EDUC 40, 38 (1963)	301490
CA 58, 5081 (1963)	301490
JONES, M MARSH, R	300909
PREPARATION AND STRUCTURE OF MgB ₂	300909
JACS 76, 1434 (1954)	300909
CA 48, 7378 (1954)	300909
JONES, P	200984
OXIDES OF EUROPIUM, GADOLINIUM, PRASEODYMIUM, AND SAMARIUM	200984

AT ENERGY RESEARCH ESTAB (GT BRIT) BIBLIOGRAPHIES	200984
BIB 130, (1960)	200984
CA 55, 12129 (1961)	200984
JONES, P	201004
(U.K.A.E.A. HARWELL ENGLAND)	201004
URANIUM CARBIDES- A BIBLIOGRAPHY OF REFERENCES UP TO THE END	201004
OF 1959	201004
AT ENERGY RESEARCH ESTAB (GT BRIT) AERE-BIB 129, (1960)	201004
CA 55, 13147 (1961)	201004
NSA 15, 17239 (1961)	201004
JONES, W GORDON, J LONG, E	400555
THE HEAT CAPACITIES OF URANIUM, URANIUM TRIOXIDE AND URANIUM	400555
DIOXIDE FROM 15 DEGREES K TO 300 DEGREES K	400555
J CHEM PHYS 20, 695 (1952)	400555
NSA 6, 4298 (1952)	400555
CA 46, 10842 (1952)	400555
JØRGENSEN, C	600928
(TECH U. DENMARK COPENHAGEN DENMARK)	600928
STUDIES OF ABSORPTION SPECTRA VII SYSTEMS WITH THREE	600928
OR MORE ELECTRONS	600928
MAT FYS MEDD 29, NO 11 29 (1955)	600928
CA 49, 10724 (1955)	600928
JØRGENSEN, P	200924
(UNIV OF UTAH SALT LAKE CITY UTAH)	200924
KINETICS OF OXIDATION OF SILICON CARBIDE	200924
UNIV MICROFILMS (ANN ARBOR, MICH) L C CARD NO MIC 60-3375,	200924
DISSERTATION ABSTR 21, 775 (1960)	200924
CA 55, 8000 (1961)	200924
JØRGENSEN, P WADSWORTH, M CUTLER, I	200772
KINETICS OF THE OXIDATION OF SILICON CARBIDE	200772
SILICON CARBIDE, PROC CONF, BOSTON 1959, 241 (1960)	200772
CA 55, 6996 (1961)	200772
JØSHI, K	201984
(UNIV ALLAHABAD INDIA)	201984
FLAME SPECTRUM OF MN0 MOLECULE IN THE VISIBLE REGION	201984
SPECTROCHIM ACTA 18, 625 (1962)	201984
CA 58, 2026 (1963)	201984
JØSHI, S MITRA, S	200999
(UNIV ALLAHABAD ALLAHABAD INDIA)	200999
DEBYE TEMPERATURE THETA OF SOME CRYSTALS	200999
INDIAN J PHYS 34, 537 (1960)	200999
CA 55, 13031 (1961)	200999
JØSHI, S MITRA, S	200767
DEBYE CHARACTERISTIC TEMPERATURE OF SOLIDS	200767
PROC PHYS SOC (LONDON) 76, 295 (1960)	200767
CA 55, 7019 (1961)	200767
JUDD, B	300804
LOW LYING LEVELS IN CERTAIN ACTINIDE ATOMS	300804
PHYS REV 125, 613 (1962)	300804
PA 65, 3685 (1962)	300804
JUDD, B	600927
(U. OF OXFORD OXFORD ENGLAND)	600927
OPERATOR EQUIVALENTS AND MATRIX ELEMENTS FOR THE EXCITED	600927

STATES OF RARE EARTH IONS PROC ROY SOC A227, 552 (1955) CA 49, 7359 (1955)	600927 600927 600927
JUDD, B (CLARENDON LAB OXFORD ENGLAND) THE STRUCTURES OF THE GROUND MULTIPLETS OF CERTAIN RARE EARTH IONS PROC PHYS SOC 69, 157 (1956) CA 50, 16371 (1956)	601027 601027 601027 601027 601027 601027
JUDD, B MARQUET, L (UNIV OF CAL BERKELEY CAL) ENERGY LEVELS OF ER II J OPTICAL SOC AM 52, 504 (1962)	300801 300801 300801 300801
JUNGMAN, V CORRECTION FOR THE CENTRIFUGAL STRETCHING OF SYMMETRICAL ROTATOR TYPE MOLECULES IN CALCULATION OF THERMODYNAMICAL FUNCTIONS ZHUR FIZ KHIM 35, 319 (1961)	700548 700548 700548 700548 700548
JUSTICE, B THERMODYNAMIC PROPERTIES AND ELECTRONIC ENERGY LEVELS OF EIGHT RARE EARTH SESQUIOXIDES (THEOIC) TID-12722 (1961) NSA 15, 17282 (1961)	601421 601421 601421 601421 601421
JUSTICE, B WESTRUM, E THERMODYNAMIC PROPERTIES OF THE LANTHANIDE OXIDES. I. HEAT CAPACITIES, THERMODYNAMIC PROPERTIES, AND SOME ENERGY LEVELS OF LANTHANUM(III) AND NEODYMIUM OXIDE FROM 5 TO 450 DEGREES K J PHYS CHEM 67, 339 (1963)	300906 300906 300906 300906 300906
JUSTICE, B WESTRUM, E THERMOPHYSICAL PROPERTIES OF THE LANTHANIDE OXIDES. II. HEAT CAPACITIES, THERMODYNAMIC PROPERTIES, AND SOME ENERGY LEVELS OF SAMARIUM(III), GADOLINIUM(III) AND YTTERBIUM(III) OXIDES FROM 10 DEGREES TO 350 DEGREES K J PHYS CHEM 67, 345 (1963)	300907 300907 300907 300907 300907
JUZA, R SCHUSTER, H THE COMPOSITION DIAGRAM CALCIUM CARBIDE-CALCIUM OXIDE ZEIT ANORG U ALLGEM CHEM 311, 62 (1961)	600840 600840 600840
KAKUSHADZE, T ELECTRON HEAT CAPACITY IN TRANSITION METALS AND ALLOYS ANN PHYS (GERMANY) 8, NO 7-8, 360 (1961) PA 65, 581, (1962)	300818 300818 300818 300818
KALININA, A A SHAMRAI, F I PHYSICO-CHEMICAL INVESTIGATIONS OF THE SiC-B4C SECTION OF THE Si-B-C SYSTEM TRANS AKAD NAUK SSSR INST METALLURGI TRUDY 1960, NO 5, 151 AD 299155 OTS 63-13363 TAB 63-2-6 (1963)	301257 301257 301257 301257 301257 301257 301257
KAMAMURA, T HAYASHI, K (NIPPON ELEC CO KAWASAKI JAPAN) PREPARATION OF SILICON CARBIDE SINGLE CRYSTALS J PHYS SOC (JAPAN) 17, 1517 (1962)	301492 301492 301492 301492

CA 58, 984 (1963)	301492
KANAZAWA, E PACKER, C	600628
SPECIFIC HEATS OF BERYLLIUM AND AN ALLOY AT ROOM AND	600628
ELEVATED TEMPERATURES	600628
LMSD 2, 288140 (1958)	600628
NSA 14, 24553 (1960)	600628
KANDYBA, V KANTØR, P ET AL	700533
DETERMINATION OF ENTHALPY AND THERMAL CAPACITY OF	700533
BERYLLIUM OXIDE IN THE TEMPERATURE RANGE FROM 1200 TO	700533
2820 DEG K	700533
AEC TR. 4310	700533
DOKLADY AKAÐ NAUK SSSR 131, NØ 3 566 (1960)	700533
NSA 15, 3108 (1961)	700533
TT 5, 299 (1961)	700533
KANTØR, P KISIL, Ø FOMICHEV, E	300274
ENTHALPY AND HEAT CAPACITY MEASUREMENTS OF SILICON FROM	300274
1200 TO 1900 DEG K	300274
UKRAINE FIZ ZHUR 5, 358 (1960)	300274
CA 55, 3180 (1961)	300274
KANTØR, P KRASOVITSKAYA, R KISEL, A	700955
(STATE INST MEASURING INSTR KHARKØV USSR)	700955
DETERMINING THE ENTHALPY AND SPECIFIC HEAT CAPACITY OF	700955
BERYLLIUM IN THE INTERVAL 600-2200 DEGREE K	700955
FIZ METAL I METALLØV 10, 835 (1960)	700955
NP-TR-705	700955
CA 55, 10037 (1961)	700955
NSA 15, 24864 (1961)	700955
KANTØR, P LAZAREVA, L KANDYBA, V FOMICHEV, E	300683
(STATE INST STDS KHARKØV USSR)	300683
EXPERIMENTAL MEASUREMENTS OF ENTHALPY, TEMPERATURE,	300683
AND HEAT OF MELTING OF ALPHA-AL ₂ O ₃ AT 1200-2500 DEGREE K	300683
UKR FIZ ZH 7, 205 (1962)	300683
CA 57, 1632 (1962)	300683
KAPUSTINSKII, A	200893
THERMOCHEMISTRY OF ALLOYS	200893
RØCZNIKI CHEM 34, 683 (1960)	200893
CA 55, 6326 (1961)	200893
KAPUSTINSKII, A	600627
THERMOCHEMISTRY AND THE STRUCTURE OF ATOMS II THE	600627
THERMOCHEMICAL LOGARITHMIC RULE AND THE HEATS OF FORMATION	600627
OF OXIDES AND HYDRIDES	600627
NP-TR-472	600627
NS 14, 24126 (1960)	600627
KARAREVA, L KANTØR, P KANDYBA, V	300344
ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM IN THE 1200-2500	300344
TEMPERATURE RANGE DEG K	300344
FIZ METAL I METALLØV XI, 628 (1961)	300344
CØTS 46,181 (1961)	300344
KARELIN, V NESMEYANØV, A PRISELKØV, Y	300914
MØRE ACCURATE VALUE OF VAPØR PRESSURE OF METALLIC YTTRIUM	300914
IZV A N Ø T N MET I TØPLIVØ 1962, NØ 5, 117 (1962)	300914
KARELIN, V NESMEYANØV, A PRISELKØV, Y	601594
(MØSCØW UNIV MØSCØW RUSSIA)	601594

THE VAPOR PRESSURE OF SCANDIUM METAL DOKLADY AKAU NAUK SSSR 144, 352 (1962) NSA 16, 25778 (1962)	601594 601594 601594
KARELIN, V NESMEYANOV, A PRISELKOV, Y CHOU, K MEASUREMENT OF VAPOR PRESSURE OF METALLIC YTTRIUM VESTN MOSK UNIV SER II KHIM 17, 40 (1962) BHT NO 4 (1962) CA 57, 6633 (1962)	700701 700701 700701 700701 700701
KAREV, V KLYUCHAREV, O NOZAROVA, T NIKOLAICHUK, A RESHETOVA, L (PHYS TECH INST KHARKOV RUSSIA) FOILS OBTAINED BY THERMAL DISSOCIATION UKR FIZ ZH 8 (6), 628 (1963). CA 59, 7205 (1963)	202064 202064 202064 202064 202064 202064
KAROPETYANTS, M METHOD OF CALCULATING PHYSICOCHEMICAL CONSTANTS KHIM PROM 33 (1961) RUSS ACC 15, NO 4, 1202 (1962)	700617 700617 700617 700617
KARPACHEV, S KARASIK, E ON THE LATENT HEAT OF FUSION OF SOME INORGANIC SALTS ZHUR FIZ KHIM 34, 1072 (1960) BHT, OCTOBER, 24 (1960)	300138 300138 300138 300138
KASKAN, W MACKENZIE, J MILLIKAN, R ORIGIN OF THE GREEN BANDS IN THE BORON-OXYGEN SYSTEM J CHEM PHYS 34, 570 (1961) PA 64, 4937 (1961)	600700 600700 600700 600700
KATHAVATE, Y RIHANI, G (INDIAN AGR RES INST NEW DELHI INDIA) VOLATILIZATION OF BORON IN THE DIRECT-CURRENT ARC CURRENT SCI (INDIA) 32, NO 4, 158 (1963) CA 59, 5896 (1963)	301493 301493 301493 301493 301493
KATZ, J (ARGONNE NATL LAB LEMONT ILL) CHEMISTRY OF URANIUM TID-5290 (1958) NSA 13, 13235 (1959)	601533 601533 601533 601533 601533
KATZ, J OXIDE SYSTEMS OF THE ACTINIDE ELEMENTS RECORD CHEM PROGRESS 12, 43 (1951) CA 45, 7906 (1951)	400534 400534 400534 400534
KATZ, J RABINOWITCH, E THE CHEMISTRY OF URANIUM MCGRAW HILL BOOK CO (1951) CA 46, 3894 (1952)	400578 400578 400578 400578
KATZ, S (GEN MOTORS CORP WARREN MICH) HIGH-TEMP REACTIONS BETWEEN REFRACTORY URANIUM COMPOUNDS AND METALS J NUCL MATER 6, 172 (1962) CA 58, 1188 (1962)	201971 201971 201971 201971 201971
KATZ, T MARGRAVE, J (U. WISCONSIN MADISON WISCONSIN)	600933 600933

FREE ENERGY FUNCTIONS FOR GASEOUS ATOMS FROM HYDROGEN (Z=1) TO NI0BIUM(Z=41)	600933 600933
J CHEM PHYS 23, 983 (1955)	600933
CA 49, 10720 (1955)	600933
KATZIN, L	601020
(ARGONNE NAT LAB LEMONT ILLINOIS)	601020
RECENT DEVELOPEMENTS IN THE CHEMISTRY OF THORIUM	601020
PROC INTERN CONF PEACEFUL USES ATOMIC ENERGY, GENEVA	601020
1955 7, 407 (1956)	601020
CA 50, 14420 (1956)	601020
KAUFMAN, L	300910
(MAN LABS INC CAMBRIDGE MASS)	300910
ESTIMATION OF THE ENTROPY OF NaCl-TYPE COMPOUNDS	300910
TRANS AIME 224, 1006 (1962)	300910
CA 57, 15898 (1962)	300910
KAUFMAN, L BERNSTEIN, H	300932
(MFG LABS INC CAMBRIDGE MASS)	300932
THERMODYNAMICS OF INTERSTITIAL SOLID SOLUTIONS	300932
ASD-TR 61-445 PT 2 (1962)	300932
AD 285984	300932
KAUFMANN, A	601429
NUCLEAR REACTOR FUEL ELEMENTS, METALLURGY AND FABRICATION	601429
INTERSCIENCE PUBLISHERS, N.Y. (1962)	601429
NSA 16, 16654 (1962)	601429
KAUFMANN, A GORDON, P LILLIE, D	500129
(MIT CAMBRIDGE MASS)	500129
THE METALLURGY OF BERYLLIUM	500129
TRANS AM SOC METALS 42, 785 (1950)	500129
CA 44, 5775 (1950)	500129
KAUFMANN, A RAPPERPORT, E	300218
REFRACTORY METALS CONSTITUTION DIAGRAMS	300218
AD 249190 (1961)	300218
KAUFMANN, A RAPPERPORT, E SMITH, M WULFF, J BROPHY, J	202065
GRANT, N GRESSIN, B TAYLOR, A DOYLE, N	202065
(NUCLEAR METALS INC CONCORD MASS)	202065
REFRACTORY METAL CONSTITUTION DIAGRAMS	202065
US DEPT COMM OFFICE TECH SERVICE PB171391 (1960)	202065
CA 57, 13507D (1962)	202065
KAUFMAN, L CLOUGHERTY, E WEISS, R	301495
(MANUFACTURING LABS CAMBRIDGE MASS)	301495
THE LATTICE STABILITY OF METALS	301495
ACTA MET 11, 323 (1963)	301495
CA 58, 13229 (1963)	301495
KAWAI, K MURATA, H	200805
NORMAL VIBRATIONS AND THERMODYNAMIC PROPERTIES OF	200805
CR AND MO HEXACARBONYLS	200805
BULL CHEM SOC JAPAN 33, 1008 (1960)	200805
CA 55, 1183 (1961)	200805
KAWASAKI, M NAGASAKI, R ITAGAKI, M TAKEMURA, T	201491
U S AT ENERGY COMM AEC-TR-4468 (1960)	201491
URANIUM MOLYBDENUM ALLOYS	201491
CA 56, 12623 (1962)	201491

KAY, D TAYLOR, J	300131
ACTIVITIES OF SILICA IN THE LIME AND ALUMINA AND SILICA SYSTEM	300131
TRANS FAR SOC 56, 1372 (1960)	300131
BHT, OCTOBER, 11 (1960)	300131
KAY, D A R TAYLOR, J	202066
IRON COLL SCI TECHNOL GLASGOW SCOTLAND)	202066
THE SILICA REDUCTION REACTION IN THE BLAST FURNACE	202066
J IRON STEEL INST (LONDON) 201, 67 (1963)	202066
CA 58, 9903G (1963)	202066
KAYF, G	201909
(MORGANITE RES DEV LTD LONDON ENGLAND)	201909
FACE-CENTERED CUBIC MOLYBDENUM MONOCARBIDE	201909
NATURE 195, 1195 (1962)	201909
CA 57, 14520 (1962)	201909
KEENAN, P SCHRÖEDER, L	600911
AN INFRARED SYSTEM OF BANDS OF V0 IN M-TYPE STARS	600911
ASTROPHYS J 115, 82 (1952)	600911
CA 46, 4358 (1952)	600911
KEESOM, P PEARLMAN, N	300170
ATOMIC HEAT OF SILICON AND GERMANIUM AT VERY LOW TEMPERATURES	300170
PHYS REV 85, NO 4 730 (1952)	300170
KELER, E ANDREEVA, A	201888
SOLID SOLUTIONS OF THE SYSTEM ZR02-Si02	201888
OGNEUPORY 27, 577 (1962)	201888
CA 57, 13421 (1962)	201888
KELER, E GÖDINA, N	600866
CONDITIONS OF FORMATION OF SOLID SOLUTIONS IN THE SYSTEM	600866
CE02-SR0	600866
AEC-TR-4051 PGS-319-24	600866
ZHUR NEORG KHIM 2, 209 (1957)	600866
NSA 15, 8791 (1961)	600866
KELER, E ANDREEVA, A	301496
THE FORMATION AND PROPERTIES OF SOLID SOLUTION OF	301496
ZIRCONIUM DIOXIDE WITH RARE EARTH OXIDES	301496
OGNEUPORY 28, 224 (1963)	301496
CA 59, 3623 (1963)	301496
KELER, E GÖDINA, N DEGEN, M	300264
ELECTRON MICROSCOPIC AND THERMOGRAPHIC STUDY OF SOLID-PHASE	300264
REACTIONS IN BINARY SYSTEMS OF HF02 WITH BA0, SR0, CA2	300264
ZHUR PRIKLAD KHIM 34, 1769 (1961)	300264
CT NO 20, 92 (1961)	300264
CA 56, 987 (1962)	300264
KELER, E GÖDINA, N SAVCHENKO, E	300387
REACTIONS BETWEEN SILICA AND RARE EARTH OXIDES (LA2O3, ND2O3,	300387
GD2O3) IN SOLID PHASES	300387
IZV AN SSSR OTD KHIM NAUK NO 10 1728 (1961)	300387
RUSS ACC 14, 2795 (1962)	300387
KELIER, D	601445
(BATTELLE MEM INST COLUMBUS OHIO)	601445
DEVELOPMENT OF URANIUM MONONITRIDE,	601445
QUART PROG REPT (1961)	601445
BMI X-178	601445
NSA 16, 3450 (1962)	601445

KELLER, D		601432
(BATTELLE MEM INST	COLUMBUS	601432
DEVELOPMENT OF URANIUM MONONITRIDE,		601432
QUART PROG REP (1961)		601432
BMI-X-186		601432
NSA 16, 15118 (1962)		601432
KELLER, E ANDREEVA, A		300222
EFFECT OF SILICA ADMIXTURE ON THE SINTERING AND STABILIZATION		300222
OF ZIRCONIUM DIOXIDE		300222
OGNEUPORY 26, NO 6 276 (1961)		300222
CT 16, 99 (1961)		300222
KELLER, J WALLACE, D		301092
ANHARMONIC CONTRIBUTION TO SPECIFIC HEAT		301092
PHYS REV 126, 1275 (1962)		301092
KELLEY, K		700865
CONTRIBUTIONS TO THE DATA ON THEORETICAL METALLURGY VIII		700865
THERMODYNAMIC PROPERTIES OF METAL CARBIDES AND NITRIDES		700865
BUR MINES BULL 407 (1937)		700865
CA 32, 2821 (1938)		700865
KELLEY, K		700891
CONTRIBUTIONS TO THE DATA ON THEORETICAL METALLURGY XIII		700891
HIGH TEMPERATURE HEAT CONTENT, HEAT CAPACITY AND ENTROPY		700891
DATA FOR THE ELEMENTS AND INORGANIC COMPOUNDS		700891
BUR MINES BULL 594, 100 (1960)		700891
KELLEY, K KING, E		700915
CONTRIBUTIONS TO THE DATA ON THEORETICAL METALLURGY XIV		700915
ENTROPIES OF THE ELEMENTS AND INORGANIC COMPOUNDS		700915
BUR MINES BULL 592, 56 (1961)		700915
KEMP, W KLEMENS, P TAINISH, R		601205
(NATL STANDARDS LAB	SYDNEY	601205
	AUSTRALIA)	601205
THERMAL AND ELECTRIC CONDUCTIVITIES OF RHODIUM AND IRON		601205
ANN PHYSIK 5, 35 (1959)		601205
CA 54, 4085 (1960)		601205
KEMPTER, C		601295
(LOS ALAMOS SCI LAB	LOS ALAMOS	601295
	N MEXICO)	601295
THE CRYSTAL STRUCTURE OF YTTRIUM NITRIDE		601295
J PHYS CHEM 61, 1237 (1957)		601295
NSA 11, 13286 (1957)		601295
KEMPTER, C ELLIOTT, R		601150
(LOS ALAMOS SCI LAB	LOS ALAMOS	601150
	N.M.)	601150
THERMAL EXPANSION OF (UN), (UO ₂), (UO ₂ -THO ₂), AND (THO ₂)		601150
J CHEM PHYS 30, 1524 (1959)		601150
CA 53, 19552 (1959)		601150
KEMPTER, C FRIES, R		201103
(LOS ALAMOS SCI LAB	LOS ALAMOS	201103
	N MEX)	201103
CRYSTALLOGRAPHY OF THE RU-B AND OS-B SYSTEM		201103
J CHEM PHYS 34, 1994 (1961)		201103
CA 55, 18236 (1961)		201103
KEMPTER, C KRIKORIAN, N		300517
SOME PROPERTIES OF THORIUM MONOCARBIDE AND DICARBIDE		300517
J LESS-COMMON METALS 4, 244 (1962)		300517
BHT NO 2, 8 (1962)		300517

KEMPTER, C KRIKORIAN, N MCGUIRE, J	700837
THE CRYSTAL STRUCTURE OF YTTRIUM NITRIDE	700837
J PHYS CHEM 61, 1237 (1957)	700837
CA 52, 11511 (1958)	700837
KEMPTER, C NADLER, M	201024
(LOS ALAMOS SCI LAB LOS ALAMOS N MEX)	201024
PREPARATION AND CRYSTAL STRUCTURES OF RUC AND OSC	201024
J CHEM PHYS 33, 1580 (1960)	201024
CA 55, 14003 (1961)	201024
KEMPTER, C STØRMS, E FRIES, R	201053
(LOS ALAMOS SCI LAB LOS ALAMOS N MEX)	201053
LATTICE DIMENSIONS OF NBC AS A FUNCTION OF STOICHIOMETRY	201053
J CHEM PHYS 33, 1873 (1960)	201053
CA 55, 16167 (1961)	201053
KENDALL, E HAYS, C SWIFT, R	201095
(UNIV OF KENTUCKY LEXINGTON KENTUCKY)	201095
THE ZIRCONIUM-PLATINUM ALLOY SYSTEM	201095
TRANS AIME 221, 445 (1961)	201095
CA 55, 17447 (1961)	201095
KENDALL, W	601684
THERMODYNAMIC PROPERTIES OF URANIUM GAS	601684
J CHEM ENG DATA 7, NO 4, 540 (1962)	601684
KENDALL, W ØRR, R HULTGREN, R	601674
(UNIV OF CAL BERKELEY CAL)	601674
HEAT CONTENT OF PLATINUM	601674
J CHEM ENG DATA 1, 516 (1962)	601674
BHT NO 4 (1962)	601674
KENNEDY, D RITCHIE, M MACKENZIE, J	300225
THE PHOTOSORPTION OF OXYGEN AND NITRIC OXIDE ON TITANIUM OXIDE	300225
TRANS FAR SOC 54, 119 (1958)	300225
KERR, W	601461
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	601461
LITERATURE SURVEY-URANIUM MONONITRIDE	601461
NAA-SR-MEMO 7208 (1962)	601461
NSA 16, 22533 (1962)	601461
KESSLER, D	400576
THE CONFIGURATION FDS PLUS FS2 OF TH II	400576
PHYSICA 17, 913 (1951)	400576
CA 46, 3852 (1952)	400576
KESSLER, K MEGGERS, W MOORE, C	600976
(NAT BUR STDS WASHINGTON D.C.)	600976
EXTENSION OF THE ARC SPECTRA OF PALLADIUM AND PLATINUM	600976
(6500-12000 ANGSTROMS)	600976
J NAT BUR STANDARDS 53, 225 (1954)	600976
CA 49, 5119 (1955)	600976
KEVANE, C	601467
(ARIZONA STATE UNIV ARIZONA)	601467
ELECTRICAL PROPERTIES OF OXIDES OF SOME LANTHANIDE RARE	601467
EARTH ELEMENTS	601467
AFOSR-2230 (1962)	601467
NSA 16, 18020 (1962)	601467

KHACHATURYAN, A	202067
(INST METALLOG + PHY METALS MOSCOW RUSSIA)	202067
APPLICATION OF THE GREEN FUNCTION METHOD TO THE	202067
THERMODYNAMICS OF INTERSTITIAL SOLUTIONS	202067
FIZ TVERD TELA 5, 15 (1963)	202067
KHACHKURUZOV, G MILEVSKAYA, I	700677
CALCULATION OF THERMODYNAMIC FUNCTIONS OF POLYATOMIC GASES	700677
WITH NON-RIGID MOLECULES. PART 2. NON-LINEAR SYMMETRICAL	700677
MOLECULES XY ₂	700677
ZHUR FIZ KHIM 35, 142 (1961)	700677
CCP NO 6, 492 (1961)	700677
KHITROVA, V PINSKER	301110
CHEMICAL CRYSTALLOGRAPHY OF TUNGSTEN NITRIDES AND OF SOME	301110
OTHER INTERSTITIAL PHASES	301110
KRISTALLOGRAFIYA 6, NO 6 882 (1961)	301110
COTS 54, 321 (1962)	301110
CA 57, 2950 (1962)	301110
KHITROVA, V PINSKER, Z	201620
ELECTRON DIFFRACTION INVESTIGATION OF CUBIC TUNGSTEN NITRIDE	201620
KRISTALLOGRAFIYA 4, 545 (1959)	201620
CA 57, 2951 (1962)	201620
KHITROVA, V PINSKER, Z	201619
STRUCTURE II OF HEXAGONAL TUNGSTEN NITRIDE	201619
KRISTALLOGRAFIYA 5, 711 (1960)	201619
CA 57, 2950 (1962)	201619
KHLAPOVA, A	301146
X-RAY DATA ON THE ALPHA TO BETA QUARTZ PHASE TRANSITION	301146
SOVIET PHYSICS CRYSTALLOGRAPHY VOL 7, NO 4, 403 (1963)	301146
COTS 61, 236 (1963)	301146
KHLAPOVA, A	201848
X-RAY DATA ON THE PHASE TRANSITION ALPHA (QUARTZ)	201848
BETA-QUARTZ	201848
KRISTALLOGRAFIYA 7, 568 (1962)	201848
CA 57, 11937 (1962)	201848
KHLERNIKOV, G SIMANOV, Y NEMKOVA, O	201625
SOLID PHASE REACTIONS BETWEEN CA, V ₂ O ₅ AND U ₃ O ₈	201625
ISSLED V OBL KHIM URANA, SB STATEI 1961, 292	201625
CA 57, 3069 (1962)	201625
KHOMYAKOV, K SPITSYN, V ZHVANKO, S	300729
TRUE HEAT CAPACITY OF U ₃ O ₈	300729
ISSLED V OBL KHIM URANA SB STATEI 1961, 141 (1961)	300729
CA 57, 2929 (1962)	300729
KHRIPUN, M K ARIYA, S M MOROZOVA, M P	301258
ENTHALPY OF FORMATION OF TITANIUM CARBIDES AND OXYCARBIDES	301258
ZHUR OSHCHEI KHIM 32, 2072 (1962)	301258
COTS 65, 310 (1963)	301258
KIBLER, G LYON, T DESANTIS, V	300427
(GE CO CINCINNATI OHIO)	300427
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH	300427
VOL II REFRACTORY MATERIAL	300427
SEVENTH QUARTERLY REPORT 31 MAR 1962 CONTRACT AF33(616)-6841	300427
KIBLER, G LYON, T	601575

IGE CO	CINCINNATI	OHIO	601575
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS			601575
RESEARCH - 6TH QUART PROG REPT OCT 1, 1961- DEC 31, 1961			601575
CONTRACT NO AF33(616)-6841 ARPA ORDER 24-61 TASK 6			601575
NP-11264 (1961)			601575
NSA 16, 9142 (1962)			601575
KIBLER, G M	LYON, T F		301260
REFRACTORY MATERIALS RESEARCH			301260
QUARTERLY PROG REPT NO 9, OCT-DEC (1962)			301260
AD 295855			301260
TAB 63-2-3, 155 (1963)			301260
KIBLER, G M	LYON, T F	LINEVSKY, M J	301259
REFRACTORY MATERIALS RESEARCH			301259
QUARTERLY PROCESS REPT NO 10, JAN-MARCH (1963)			301259
AD 403529			301259
TAB 63-3-4, 175			301259
KIEFFER, R	BENESOVSKY, F		301261
IMETALWERK PLANSEE AG	TIROL	AUSTRIA)	301261
DEVELOPMENTS IN THE DOMAIN OF HARD METALS			301261
RADEX RUNDSHAU (1), 351 (1963)			301261
BHT NO 2, 26 (1963)			301261
KIEFFER, R	BENESOVSKY, F		600619
RECENT DEVELOPMENTS IN THE FIELD OF SILICIDES AND BORIDES			600619
OF THE HIGH MELTING POINT TRANSITION METALS			600619
POWDER MET NO 1, 145 (1958)			600619
NSA 14, 21902 (1960)			600619
KIFSS, C			600685
RED AND INFRARED BANDS OF TITANIUM AND ZIRCONIUM OXIDES			600685
PUB ASTRON SOC PACIFIC 60, 252 (1948)			600685
CA 43, 940 (1949)			600685
KIESS, C			201678
(NATL BUR STANDARDS	WASHINGTON	D C)	201678
DESCRIPTION AND ANALYSIS OF THE SECOND SPECTRUM OF TANTALUM			201678
TA II			201678
J RES NATL BUR STDS A66, 111 (1962)			201678
CA 57, 4188 (1962)			201678
KIESS, C			600686
WAVE LENGTHS OF THE (0,0) BAND HEADS IN THE INFRARED			600686
SYSTEM OF CN			600686
ASTROPHYS J 109, 531 (1949)			600686
CA 43, 7338 (1949)			600686
KIEFFER, R	BENESOVSKY, F		301497
NEW DEVELOPMENTS IN THE FIELD OF HARD MATERIALS AND			301497
HARD ALLOYS			301497
CA 58, 12239 (1963)			301497
KIHLBORG, L			201174
(UNIV UPPSALA	UPPSALA	SWEDEN)	201174
MOLYBDENUM OXIDE			201174
ACTA CHEM SCAND 13, 954 (1959)			201174
CA 55, 23144 (1961)			201174
KIHLBORG, L			202068
(UNIV OF UPPSALA	UPPSALA	SWEDEN)	202068
THE EXISTENCE OF THE SUBOXIDES CR3O AND MO3O			202068

ACTA CHEM SCAND 16, 2453 (1963)	202068
CA 58, 8611F (1963)	202068
KIM, W	301499
(EWHAN WOMANS UNIV	301499
ZEOL	301499
A PARTITION FUNCTION OF LI AND METAL	301499
J KOREAN CHEM SOC 6, 36 (1963)	301499
CA 58, 13150 (1963)	301499
KIMURA, H SASAKI, Y	301262
THE VACUUM REDUCTION OF NIOBIUM PENTOXIDE WITH NIOBIUM	301262
CARBIDE	301262
NIPPON KINZOKU GAKKAI JHI 26, 695 (1962)	301262
BHT NO 2, 44 (1963)	301262
KIMURA, H SASAKI, Y	601578
(NAT RES INST MET, SCI, TECH TOKYO	601578
JAPAN)	601578
THE PHASE DIAGRAM OF THE NIOBIUM-CARBON SYSTEM	601578
TRANS JAPAN INST MET (SENDAI) 2, 98 (1961)	601578
NSA 16, 7914 (1962)	601578
CA 56, 9842 (1962)	601578
KING, E CHRISTENSEN, A	600826
(BUREAU OF MINES	600826
BERKELEY	600826
CAL)	600826
HIGH TEMPERATURE HEAT CONTENTS AND ENTROPIES OF CERIUM	600826
DIOXIDE AND NIOBIUM DIOXIDE	600826
US BUR MINES REPT INVEST NO. 5789 (1961)	600826
CA 55, 19450 (1961)	600826
NSA 15, 23930 (1961)	600826
KING, E KOEHLER, M ADAMI, L	301500
HEATS AND FREE ENERGIES OF FORMATION OF CALCIUM AND	301500
MAGNESIUM VANADATES	301500
BUR MINES REPT 6049, (1962)	301500
KING, E WELLER, W CHRISTENSEN, A	700973
(BUREAU OF MINES	700973
BERKELEY	700973
CAL)	700973
THERMODYNAMICS OF SOME OXIDES OF MO AND W	700973
BM-RI-5664 (1960)	700973
CA 55, 4135 (1961)	700973
NSA 15, 614 (1961)	700973
KING, E WELLER, W CHRISTENSEN, A KELLEY, K	300735
SOME THERMODYNAMIC VALUES FOR FOUR TITANIUM HALIDES	300735
US BUR MINES DEPT. INVEST 5799 20 (1961)	300735
CA 56, 4164 (1962)	300735
KING, E WELLER, W PANKRATZ, L	300712
THERMODYNAMIC DATA FOR LANTHANUM SESQUIOXIDE	300712
US BUR MINES REPT INVEST NO 5857, 6 (1961)	300712
CA 56, 10995 (1962)	300712
KING, J	200813
THERMOCHEMISTRY OF RHENIUM COMPOUNDS	200813
UNIV MICROFILMS (ANN ARBOR, MICH.) L C CARD NO MIC 60-2217,	200813
DISSERTATION ABSTR 21, 69 (1960)	200813
CA 55, 2264 (1961)	200813
KINGERY, W	301263
INTRODUCTION OF CERAMICS	301263
JOHN WILEY NY (1960)	301263
KINGERY, W FRANCL, J COBLE, R VASILIOS, T	600971

THERMAL CONDUCTIVITY X DATA FOR SEVERAL PURE OXIDE MATERIALS CONNECTED TO ZERO POROSITY J AM CERAM SOC 37, 107 (1954) CA 48, 4789 (1954)	600971 600971 600971 600971
KINNE, G VISHKAREV, A THERMODYNAMICS OF THE DEOXIDATION OF STEEL BY MEANS OF LANTHANUM, CERIUM, PRASEODYMIUM AND NEODYMIUM IZ VYSSHIKH UCHEB ZAVED CHERN MET, NO 2, 1962, 92 (1962) HB 5754 COTS 187, MARCH, (1963)	301147 301147 301147 301147 301147 301147
KIRCHNER, H P KNOLL, P SILICON CARBIDE WHISKERS J AM CERAM SOC 46, 299 (1963)	202069 202069 202069
KIREEV, V EFFECT OF TEMPERATURE ON THE ATOMIC ENTROPY OF FORMATION OF INORGANIC SUBSTANCES ZH FIZ KHIM 37, NO 1, 211 (1963)	300913 300913 300913 300913
KIRILLIN, V SHEINDLIN, A CHEKHOVSKOI, V ENTHALPY AND SPECIFIC HEAT OF TUNGSTEN IN THE 0-2400 DEG C TEMPERATURE RANGE DOKL AKAD NAUK SSSR 142, NO 6, 1323 (1962) BHT NO 2, 27 (1962) CA 57, 1632 (1962)	300531 300531 300531 300531 300531 300531
KIRILLIN, V SHEINDLIN, A CHEKHOVSKOI, V (HIGH TEMP LAB ACAD SCI MOSCOW USSR) EXPERIMENTAL DETERMINATION OF THE ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM UP TO 2337 DEGREES C INTERN J HEAT AND MASS TRANSFER 5, 1 (1962) NSA 16, 15212 (1962) CA 57, 2933 (1962)	601564 601564 601564 601564 601564 601564
KIRILLIN, V SHEINDLIN, A CHEKHOVSKOI, V (HIGH TEMP LAB ACAD SCI MOSCOW USSR) EXPERIMENTAL DETERMINATION OF THE ENTHALPY OF MOLYBDENUM AT 700-2337 DEGREES C DOKLADY AKAD NAUK SSSR 139, 641 (1961) BHT 4, 21 (1961) CA 56, 11002 (1962)	300921 300921 300921 300921 300921 300921
KIRILLIN, V SHEINDLIN, A CHEKHOVSKOI, V THERMODYNAMIC PROPERTIES OF TUNGSTEN IN THE TEMPERATURE RANGE 0 TO 2400 DEGREES C TEPLOENERGETIKA 9, NO 2, 63 (1962) CA 57, 1632 (1962)	300689 300689 300689 300689 300689
KIRILLIN, V SHEINDLIN, A CHEKHOVSKOI, V PETROV, V AN EXPERIMENTAL STUDY OF THE ENTHALPY OF TUNGSTEN IN THE 2400-2820 DEG C TEMPERATURE RANGE DOKL AKAD NAUK SSSR 144, 390 (1962)	300360 300360 300360 300360
KIRILLIN, V VUKALOVICH, M FUTURE DEVELOPMENTS IN POWER ENGINEERING AND NEW PROBLEMS IN THE PHYSICS OF HEAT TEPLOENERGETIKA 8, NO 6 3 (1961) RUSS ACC 14, NO 10 2813 (1962)	300378 300378 300378 300378 300378
KIRILLOVA, G MEERSON, G ZELIKMAN, A KINETICS OF CHLORINATION OF TITANIUM AND NIOBIUM CARBIDES	200759 200759

IZVEST VYSSHIKH UCHEB ZAVEDENII TSVETNAYA MET 3,90 (1960)	200759
CA 55, 5096 (1961)	200759
KIRKWOOD, D CHIPMAN, J	700634
THE FREE ENERGY OF SILICON CARBIDE FROM ITS SOLUBILITY IN	700634
MOLTEN LEAD	700634
J PHYS CHEM 65, 1082 (1961)	700634
KIRSHENBAUM, A	201183
(TEMPLE UNIV PHILADELPHIA PA)	201183
DENSITY OF MOLTEN THORIUM AND URANIUM TETRAFLUORIDES	201183
J INORG AND NUCLEAR CHEM 19, 65 (1961)	201183
CA 56, 33 (1962)	201183
KIRSHENBAUM, A CAHILL, J STOKES, C	200897
DENSITY OF MOLTEN METAL FLUORIDES IN THE RANGE 1600-	200897
2500 DEGREES K	200897
J INORG + NUCLEAR CHEM 15, 297 (1960)	200897
CA 55, 6968 (1961)	200897
KISER, R	200784
TABLE OF IONIZATION POTENTIALS	200784
US AT ENERGY COMM TID-6142, (1960)	200784
CA 55, 93 (1961)	200784
KISHKO, S	300796
EXCITATION FUNCTIONS OF CERTAIN CO AND CO PLUS BANDS IN	300796
THE VISIBLE REGION OF THE SPECTRUM	300796
UKRAIN FIZ ZH 5, 375 (1960)	300796
PA 65, 6174 (1962)	300796
KISLY, P SAMSONOV, G	300137
DIFFUSION OF BORON IN CARBON	300137
FIZ TVERD TELA 2, 1729 (1960)	300137
KISLY, P SAMSONOV, G	300496
HIGH TEMPERATURE THERMOELEMENTS FROM SEMICONDUCTORS	300496
PLANSEEBER PULVERMET 8, 200 (1961)	300496
BHT NO 3, 19 (1961)	300496
KISTIAKOWSKY, G WARNECK, P	600588
LEWIS RAYLEIGH NITROGEN AFTERGLOW	600588
J CHEM PHYS 27, 1417 (1957)	600588
CA 52, 5120 (1958)	600588
KIUKKOLA, K	601469
(INST TECH OTANIEMI FINLAND)	601469
HIGH TEMPERATURE ELECTROCHEMICAL STUDY OF	601469
URANIUM OXIDES IN THE UO2-U3O8 REGION	601469
ACTA CHEM SCAND 16, 327 (1962)	601469
NSA 16, 18860 (1962)	601469
KIVEL, B MAYER, H	600609
OPACITY OF AIR AT HIGH ALTITUDES AND HIGH TEMPERATURES	600609
LA 1738, (1954)	600609
NSA 14, 18233 (1960)	600609
KLAUS, K	600973
SELECTED WORKS ON CHEMISTRY OF PLATINUM METALS	600973
IZDATELSTVO AKADEMIY NAUK SSSR 24, NO 8, 130 (1954)	600973
CA 49, 2246 (1955)	600973
KLEBER, E	601450

RARE EARTH RESEARCH THE MACMILLAN CO, NY (1960) NSA 16, 1668 TO 1697 (1962)	601450 601450 601450
KLEIN, C (RES DIV RAYTHEON COMPANY WALTHAM MASS) ELECTRICAL PROPERTIES OF PYROLYTIC GRAPHITES REV MODERN PHYSICS 34, 56 (1962)	300915 300915 300915 300915
KLEIN, R LEDER, L (NATL BUR OF STDS WASHINGTON DC) FIELD-EMISSION OBSERVATIONS OF CARBON ON TANTALUM J CHEM PHYS 38, 1863 (1963) CA 58, 10778 (1963)	301501 301501 301501 301501 301501
KLEMENT JR, W JAYARAMAN, A KENNEDY, G (UNIV OF CALIFORNIA LOS ANGELES CALIF) PHASE TRANSFORMATIONS IN URANIUM AT HIGH PRESSURES PHYS REV 129, 1971 (1963) CA 58, 7444 (1963)	301502 301502 301502 301502 301502
KLEMM, W WINKELMANN, G. NITRIDES OF THE RARE EARTH METALS Z ANORG U ALLGEM CHEM 288, 87 (1956) AEC-TR-4654, CA 51, 4791 (1957) NSA 15, 22226 (1961)	700874 700874 700874 700874 700874 700874
KLEPFER, H (AMES LAB AMES IOWA) CHARACTERISTICS OF THE SOLID STATE TRANSFORMATIONS IN URANIUM ISC-893 (1957) NSA 12, 6965 (1958)	601506 601506 601506 601506 601506
KLEPPA, Ø (UNIV OF CHICAGO CHICAGO ILL) ASPECTS OF THE THERMODYNAMICS OF METALLIC SOLUTIONS J PHYS RADIUM 23, 763 (1962) CA 58, 8460 (1963)	301503 301503 301503 301503 301503
KLIMOV, V INFRARED SPECTROMETRY OF INORGANIC COMPOUNDS ZAVODSKAYA LAB 27, 292 (1961) CCP NO 7, 560	700670 700670 700670 700670
KLINGSBERG, C RØY, R SOLID-SOLID AND SOLID-VAPOR REACTIONS AND A NEW PHASE IN THE SYSTEM MN-O J AM CERAM SOC 43, 620 (1960)	700518 700518 700518 700518
KLINKENBERG, P ANALYSIS OF THE SPECTRUM OF DOUBLY IONIZED THORIUM, TH III PHYSICA 16, 618 (1950) CA 45, 10050 (1951) NSA 5, 733 (1951)	400531 400531 400531 400531 400531
KLINKENBERG, P LANG, R THE SPECTRUM OF TREBLY IONIZED THORIUM (TH IV) PHYSICA 15, 774 (1949) CA 44, 3790 (1950) NSA 4, 1067 (1950)	400522 400522 400522 400522 400522
KLINKENBERG, P VAN KLEEF, T NØRMAN, P	300776

(UNIVERSITEIT	AMSTERDAM	HOLLAND)	300776
SPECTRAL STRUCTURE OF DOUBLY AND TREBLY IONIZED HAFNIUM			300776
PHYSICA 27, 1177 (1961)			300776
CA 56, 12437 (1962)			300776
KLINKENBERG, P	VAN KLEEF, T	NØORMAN, P	701019
(UNIVERSITEIT	AMSTERDAM	HOLLAND)	701019
THE STRUCTURE AND IONIZATION POTENTIAL OF HF(III) AND HF(IV)			701019
PHYSICA 27, 151 (1961)			701019
NSA 15, 12946 (1961)			701019
KLIUCHNIKOV, N			300747
DETERMINATION OF THERMODYNAMIC CONSTANTS OF SUBSTANCES ON			300747
THE BASIS OF THEIR ORDER NUMBER IN DI MENDELEEV'S PERIODIC			300747
SYSTEM			300747
UCH ZAP MGPI NO 146, 228 (1960)			300747
RUSS ACC 15, 1109 (1962)			300747
KLØPP, W			601542
(BATTELLE MEM INST	COLUMBUS	OHIO)	601542
OXIDATION AND CONTAMINATION REA TIONS OF NIOBIUM			601542
AND NIOBIUM ALLOYS			601542
BMI-1317			601542
NSA 13, 8909 (1959)			601542
KLYACHKIN, V			200954
THE THEORY OF PHASE TRANSITIONS IN MOLECULAR CRYSTALS			200954
FIZ TVERDØGØ TELA 2, 929 (1960)			200954
CA 55, 11016 (1961)			200954
KLYUCHNIKOV, N			300659
DETERMINATION OF THERMODYNAMIC CONSTANTS OF SUBSTANCE			300659
ON THE BASIS OF ATOMIC NUMBER I. HEAT OF FORMATION			300659
OF OXIDES			300659
UCH ZAP MØSK GØS PED INST 1960, NO 146, 228 (1960)			300659
CA 56, 13623 (1962)			300659
KNAPTØN, A			201016
(ASSØC ELEC INDS	ALDERMASTØN	ENGLAND)	201016
NIOBIUM AND TANTALUM ALLOYS			201016
J LESS COMMON METALS 2, 113 (1960)			201016
CA 55, 13261 (1961)			201016
KNAPTØN, A	SAVILL, J	SIDDALL, R	201068
(ASSØCD ELEC INDS	ALDERMASTØN	ENGLAND)	201068
THE MELTING OF OSMIUM			201068
J LESS-COMMON METALS 2, 357 (1960)			201068
CA 55, 16329 (1961)			201068
NSA 15, 4320 (1961)			201068
KNIEF, G	BETTERTØN, J	SCARBØUGH, J	301264
(ØAK RIDGE NATL LAB	ØAK RIDGE	TENN)	301264
LOW TEMPERATURE SPECIFIC HEATS OF TI, ZR AND HF			301264
PHY REV 130, 1687 (1963)			301264
ØHT NO 2, 6 (1963)			301264
KNEIP, G	BETTERTØN, J		201412
(ØAK RIDGE NATL LAB	ØAK RIDGE	TENN)	201412
SPECIFIC HEATS OF SOME ZR ALLOYS			201412
PROC INTERN CONF LOW TEMP PHY, 7TH TØRØNTØ CAN 1960, 357			201412
(1961)			201412
CA 56, 9509 (1962)			201412

KNIFE, R GORDON, A	600713
SPECTRUM OF CARBON MONOXIDE - OXYGEN EXPLOSION I THE	600713
VISIBLE SPECTRUM	600713
J CHEM PHYS 23, 2097 (1955)	600713
CA 50, 2288 (1956)	600713
KNIPPENBERG, W HASNSTR, H DEKKERS, J	301265
(PHILIPS RES LAB EINDHOVEN NETHERLANDS)	301265
CRYSTAL GROWTH OF SILICON CARBIDE	301265
PHILIPS TECH REV 24, 181 (1962)	301265
BHT NO 2, 29 (1963)	301265
KNISELEY, R FASSEL, V LENTZ, C	601191
MISIDENTIFICATIONS IN THE ARC SPECTRA OF THE RARE EARTHS	601191
U S AT ENERGY COMM IS-50, (1959)	601191
CA 54, 10502 (1960)	601191
NSA 14, 6195 (1960)	601191
KNOLL, H	301266
UMWANDLUNG VON ANATAS IN BROOKIT	301266
NATURWISSENSCHAFTEN 50, 546 (1963)	301266
KØCHERØV, P GELD, P	300462
CA VAPOR PRESSURE OVER ITS ALLOYS WITH AL.	300462
TRUDY URAL POLYTECH INST IM SM KIROVA, NO 93, 141 (1959)	300462
BHTG NO 4, 6 (1962)	300462
KØEHLER, W WOLLAN, E	700754
NEUTRON DIFFRACTION STUDY OF THE STRUCTURE OF THE A-FORM OF	700754
THE RARE EARTH SESQUIOXIDES	700754
ACTA CRYST 6, 741 (1953)	700754
CA 48, 422 (1954)	700754
KØENIG, N	601366
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	601366
MATERIAL PROPERTY DATA FOR UO2	601366
NAA-SR-MEMO 2529 (1958)	601366
NSA 14, 1842 (1960)	601366
KØENIGSBERG, E KELLER, J	601002
(IOWA STATE COLLEGE AMES IOWA)	601002
EFFECT OF ELECTRONIC QUADRUPOLE-QUADRUPOLE INTERACTIONS ON	601002
THE SPECIFIC HEAT OF CERIUM METAL	601002
U S ATOMIC ENERGY COMM I S C 429, 119 (1953)	601002
CA 50, 4622 (1956)	601002
KØERNER, W DANIELS, F	600745
THE HEAT OF FORMATION OF NITRIC OXIDE AND	600745
PHOSPHORUS TRIOXIDE	600745
J CHEM PHYSICS 20, 113 (1952)	600745
CA 46, 6479 (1952)	600745
KØFSTAD, P	301267
(CENTRAL INST IND RES OSLO NORWAY)	301267
ELECTRICAL CONDUCTIVITY OF Nb2O5 AS A FUNCTION OF OXYGEN	301267
PRESSURE AT 600-1200DEGREES	301267
PHYS CHEM SOLIDS 23, 1571 (1962)	301267
CA 58, 2930 (1963)	301267
KØFSTAD, P	301505
(CENTRAL INST IND RES BLINDERN NORWAY)	301505
THE OXIDATION BEHAVIOR OF TANTALUM AT 700-1000 DEGREES	301505
J ELECTROCHEM SOC 110, 491-501 (1963)	301505

CA 58, 13564 (1963)	30150'
KØFSTAD, P	301506
(CENTRAL INST IND RES ØSLØ NØRWAY)	301506
THE ØXIDATION ØF TANTALUM AT 1000-1300 DEGREES	301506
J LESS CØMMØN METALS 5, NØ 2, 158-70 (1963)	301506
CA 58, 13562 (1963)	301506
KØFSTAD, P	301507
(CENTRAL INST IND RES ØSLØ NØRWAY)	301507
THERMØGRAVIMETRIC STUDIES ØF THE DEFECT STRUCTURE	301507
ØF RUTILE (TiO ₂)	301507
PHYS CHEM SOLIDS 23, 1579 (1962)	301507
CA 58, 3976 (1963)	301507
KØFSTAD, P	300586
(CENTRAL INST FØR IND RES ØSLØ NØRWAY)	300586
DEFECT STRUCTURE ØF TANTALUM ØXIDE	300586
J ELECTROCHEM 109, NØ 9, 776 (1962)	300586
KØFSTAD, P	201400
ØXIDATION ØF TANTALUM AT 500-700 DEGREES	201400
TIDSSKER KJEMI BERGVESEN MET 21, 196 (1961)	201400
CA 56, 8427 (1962)	201400
KØFSTAD, P	202072
(CENTRAL INST IND RES ØSLØ NØRWAY)	202072
ØXIDATION ØF TANTALUM IN ØXYGEN AT 300-550 DEGREES	202072
J INST METALS 91, 209 (1963)	202072
CA 58, 9933A (1963)	202072
KØFSTAD, P	202074
(CENTRAL INST IND RES ØSLØ NØRWAY)	202074
THE RØLE ØF ØXIDE NUCLEATION AND GRØWTH ØF ØXIDE NUCLEI IN	202074
ØXIDAT ØN ØF NIØBIUM	202074
INTERN CØGR METALLIC CØRRØSION 1ST LØNDØN ENGL 1961,	202074
181 (1962)	202074
CA 59, 8441B (1963)	202074
KØFSTAD, P ANDERSON, P	301268
(CENTRAL INST IND RES ØSLØ NØRWAY)	301268
GRAVIMETRIC STUDIES ØF THE DEFECT STRUCTURE ØF ALPHA Nb2O ₅	301268
PHYS CHEM SOLIDS 21, 280 (1961)	301268
CA 56, 15014 (1962)	301268
KØFSTAD, P ANDERSON, P KRUDTAA, Ø	201096
(CENTRAL INST IND RESEARCH ØSLØ NØRWAY)	201096
ØXIDATION ØF TITANIUM IN THE TEMPERATURE RANGE 800-1200 DEGREES	201096
J LESS CØMMØN METALS 3, 89 (1961)	201096
CA 55, 17450 (1961)	201096
KØFSTAD, P RUZICKA, D J	202073
(CENTRAL INST IND RES ØSLØ NØRWAY)	202073
DEFECT STRUCTURE ØF ZrO ₂ AND HfO ₂	202073
J ELECTROCHEM SOC 110, 181 (1963)	202073
CA 58, 8494G (1963)	202073
KØFSTAD, P KJØLLESDAL, H MARKAL, J NØRMAN, N	201952
(CENTRAL INST IND RES ØSLØW NØRWAY)	201952
HIGH TEMPERATION ØXIDATION ØF NIØBIUM	201952
US DEPT CØM ØFFICE TECH SERV P B REPT 158,139 (1960)	201952
CA 57, 16296 (1962)	201952

KØFSTAD, P KJØLLESDAL, H	201010
(CENTRAL INST IND RESEARCH BLINDERN-ØSLØ NØRWAY)	201010
OXIDATION ØF NIØBIUM IN THE TEMPERATURE RANGE 500 TØ	201010
1200 DEGREES	201010
TRANS AIME 221, 285 (1961)	201010
CA 55, 13235 (1961)	201010
KØHN, J NYE, W GAULE, G	600881
BØRØN, SYNTHESIS STRUCTURE AND PROPERTIES PROCEEDINGS ØF	600881
THE CØNFERENCE ØN BØRØN HELD AT ASBURY PARK, NJ (1959)	600881
NEW YØRK, PLENUM PRESS (1960)	600881
NSA 15, 7822 (1961)	600881
KØJIMA, T KIKUCHI, K	100183
METALLURGICAL RESEARCH ØN CERIUM METAL. VIII.	100183
J ELECTROCHEM SOC JAPAN 21, 177 (1953)	100183
CA 47, 12174 (1953)	100183
KØJIMÄ, Y SANØ, K	300189
THE SOLUBILITY ØF GRAPHITE IN NICKEL AND CØBALT AND EFFECTS ØF	300189
ALLØYING ELEMENTS	300189
TETSN-TØ-HAGAN(IØRØN AND STEEL INST ØF JAPAN, JOURNAL) 47,	300189
897 (1961)	300189
REV MET LIT, 37 (1961)	300189
KØLAKØWSKI, B	301508
(PØLISH ACAD SCI WARSAW POLAND)	301508
STRUCTURE ØF RHØMBØHEDRAL CØMPLICATED MØDIFICATION ØF BØRØN	301508
ACTA PHYS PØLON 22, 439 (1962)	301508
CA 59, 3381 (1963)	301508
KØLCHIN, Ø SUMARØKØVA, N	600873
MELTING POINTS AND ØTHER PARAMETERS ØF THE LØWER ØXIDES	600873
ØF NIØBIUM	600873
ATOMNAYA ENERG 10, 168 (1961)	600873
NSA 15, 14763 (1961)	600873
KØLFØV, V ZENKØV, I ALEKHIN, S ØKURATØV, S	300766
(MØSCØW STATE UNIV MØSCØW RUSSIA)	300766
HERMETIC CALØRIMETER WITH MAGNETIC STIRRER	300766
ZHUR FIZ KHIM 36, 910 (1962)	300766
KØLLAR, G PRØSZT, J	202075
CALCULATION ØF THE HEAT ØF VAPØRIZATION ØF ELEMENTS AND	202075
CØVALENT CØMPØUNDS BY MEANS ØF THE ANTØINE CØNSTANTS	202075
MAGY KEM FØLYØIRAT 69, 276 (1963)	202075
KØLØMØETS, N NESHØR, V SAMSONOV, G SEMENKØVITCH, S	201484
THERMØELECTRIC PROPERTIES ØF CERTAIN METAL-LIKE CØMPØUNDS	201484
ZH TEKHN FIZ 28, 2382 (1958)	201484
CA 56, 12409 (1962)	201484
KØLØMYTSEV, P	300347
REACTION ØF BØRØN AND CHRØMIUM IN NICKELBASE TERNARY ALØYS	300347
ISSLEDØVANIYA PØ ZHARØPRØCHNYM SPLAVAM 6, (1960)	300347
FTD MCL-10201	300347
CØTS 47, 201 (1961)	300347
KØLSKY, H GILMER, R GILLES, P	700838
FREE ENERGY FUNCTIONS FØR 54 GASEØUS ELEMENTS	700838
J CHEM PHYS 27, 494 (1957)	700838
LØS ALAMØS REPT LA 2110	700838
CA 52, 16 (1958)	700838

KOLSKI, T	201497
(E I DU PONT DE NEMOURS AND CO WILMINGTON DEL)	201497
REACTION OF NIOBIUM WITH OXYGEN IN THE TEMPERATURE RANGE	201497
400 TO 1325 DEGREES C (752 TO 2417 DEGREES F)	201497
AM SOC METALS, TRANS QUART 55, 119 (1962)	201497
CA 56, 12638 (1962)	201497
KOMAR, A SHREDNIK, V	300695
THE ATOMIC STRUCTURE OF SINGLE TUNGSTEN CRYSTALS	300695
UP TO 60 ANGSTROMS IN DIMENSION	300695
DOKLADY AKADEM NAUK 144, NO 3, 541 (1962)	300695
KOMAR, A TALANIN, G	200843
(ACADEMY OF SCIENCE Leningrad USSR)	200843
THE FORMATION OF CARBIDES ON THE SURFACE	200843
OF MOLYBDENUM AND TUNGSTEN SINGLE CRYSTALS	200843
VERHANDL 1, 817 (1960)	200843
CA 55, 4089 (1961)	200843
KOMAREK, K COUCOULAS, A KLINGER, N	301269
(NEW YORK UNIV NEW YORK NEW YORK)	301269
REACTIONS BETWEEN REFRACTORY OXIDES AND GRAPHITE	301269
J ELECTROCHEM SOC 110, 783 (1963)	301269
CA 59, 4776 (1963)	301269
KOMATSU, N GRANT, N	202077
THERMAL STABILITY OF CU SiO2 AND CU AL2O3 ALLOYS	202077
TRANS AIME 224, 705 (1962)	202077
CA 57, 8295H (1962)	202077
KOMISSAROVA, L N SPITSYN, V I WANG, K	202078
(MOSCOW UNIV MOSCOW RUSSIA)	202078
HAFNATES OF LANTHANUM AND NEODYMIUM	202078
DOKL AKADEM NAUK SSSR 150 (4), 816 (1963)	202078
CA 59, 7039E (1963)	202078
KOMISSAROVA, L PLYUSHCHEV, V KREMENSKAYA, I	200811
(Lomonosov Inst Chem-Technol Moscow USSR)	200811
SOLUBILITY AND THERMAL STABILITY OF ZIRCONIUM OXYCHLORIDE	200811
ZHUR NEORG KHIM 5, 586 (1960)	200811
CA 55, 2258 (1961)	200811
KOMISSAROVA, L SIMANOV, Y VLADIMIROVA, Z	200819
SOME PROPERTIES OF CRYSTALLINE MODIFICATIONS OF ZrO2	200819
ZHUR NEORG KHIM 5, 1413 (1960)	200819
CA 55, 2332 (1961)	200819
KOMJATHY, S	201434
(ARMOUR RES FOUNDATION CHICAGO ILL)	201434
THE CONSTITUTION OF SOME VANADIUM-BASE BINARY AND TERNARY	201434
SYSTEMS AND THE AGING CHARACTERISTICS OF SELECTED TERNARY	201434
ALLOYS	201434
J LESS COMMON METALS 3, 468 (1961)	201434
CA 56, 9840 (1962)	201434
KOMJATHY, S READ, R ROSTOKER, W	201394
(ILLINOIS INST OF TECHNOL CHICAGO ILL)	201394
PHASE RELATIONS IN SELECTED BINARY AND TERNARY VANADIUM-BASE	201394
ALLOYS SYSTEMS	201394
US DEPT COMM OFFICE TECH SERV PB REPT 162,816, 69 (1960)	201394
CA 56, 8415 (1962)	201394

KOMKOV, A		201418
(GEOL INST	RUSSIA)	201418
X-RAY STUDY OF RARE EARTH COMPOUNDS OF THE (Y,R) (NB,TA)O ₄		201418
TYPE		201418
MATERIALY VSESØYVZ NAUCH ISSLEDØVATEL GEOL INST (1959)		201418
NØ 26, 73 (1959)		201418
CA 56, 9541 (1962)		201418
KOMLEV, G VETRENKO, E		300421
RELATION BETWEEN THE KINETICS OF EVAPORATION OF SOLIDS AND		300421
SATURATED VAPOR PRESSURE		300421
TRUDY INST MET AKAD NAUK SSSR URAL FIBIL NØ 4, 19 (1958)		300421
BIB CHEM REV 3, 25F (1960)		300421
KONDRASHEV, Y		700942
INTER-TRANSITION OF VARIETIES OF MANGANESE DIOXIDE		700942
ZHUR NEØRG KHIM 2, NØ 12 2694 (1957)		700942
AEC-TR-4062		700942
NSA 15, 19233 (1961)		700942
KONIG, H		600944
(UNIV GÖTTINGEN	GERMANY)	600944
PLATINUM CARBIDE		600944
NATURWISSENSCHAFTEN 38, 154 (1951)		600944
CA 46, 1837 (1952)		600944
KONSTANTINOV, V AMOSOV, V		301148
PRODUCTION OF ELECTROLYTIC TA,NB AND THEIR ALLOYS		301148
TSVETN MET 35, (6) 72 (1962)		301148
BHT NØ 1, 9 (1963)		301148
KOPETSKIY, C		301270
OBTAINMENT AND PROPERTIES OF MONOCRYSTALS OF THE HIGH-		301270
MELTING METALS, TUNGSTEN, RHENIUM, TANTALUM, MOLYBDENUM AND		301270
NIØBIUM		301270
TRUDY AK NAUK SSSR INST METALL ISSLEDØVANIYA PØ ZHARPOCHNYM		301270
SPLAVAM MOÏCØW 9, 192 (1962)		301270
ØØTS 67, 124 (1963)		301270
KOPYLOVA, V		201305
CHEMICAL STABILITY OF CARBIDES OF TRANSITION ELEMENTS OF		201305
GROUPS IV, V, AND VI		201305
ZHUR PRIKLAD, KHIM 34, 1936 (1961)		201305
CA 56, 4344 (1962)		201305
KORNILOV, I I GLAZOVA, V V		202081
FORMATION OF Ti6O AND Ti3O COMPOUNDS IN THE TITANIUM		202081
OXYGEN SYSTEM		202081
DØKL AKAD NAUK SSSR 150 (2), 313 (1963)		202081
CA 59, 8428D (1963)		202081
KORNILOV, I I MIKHEEV, V S KONSTANTINOV, K M		202079
SPECIFIC ELECTRICAL RESISTANCE OF ALLOYS OF TITANIUM		202079
ALUMINUM SYSTEM FROM ROOM TEMPERATURE L' TO 1200 DEGRESS C		202079
FIZ METAL I METALLOVED 16, 57 (1963)		202079
KORNILOV, I I POLYAKOVA, R S		202080
NEW METALLIC MATERIALS FOR CHEMICAL EQUIPMENT CONSTRUCTION		202080
ZH VSES KHIM ØBSHCHESTVA IM D I MENDELEEVA 8, 305 (1963)		202080
CA 59, 7205A (1963)		202080
KORNILOV, A LEONIDOV, V SKURATOV, S		300923
STANDARD HEAT OF FORMATION OF THE HIGHER CARBIDES OF NIØBIUM		300923

AND TANTALUM	300923
VEST MØSKØV UNIV SER II KHIM 17, NØ 6, 48 (1962)	300923
KØRNILØV, A LEØNIDØV, V SKURATØV, S	601591
(MØSCØW UNIV MØSCØW RUSSIA)	601591
THE STANDARD HEATS ØF FØRMATION ØF	601591
NIØBIUM PENTØXIDE AND TANTALUM PENTØXIDE	601591
DØKLADY AKAD NAUK SSSR 144, 355 (1962)	601591
NSA 16, 25334 (1962)	601591
KØRNILØV, I	200951
METALLØCHEMICAL PRØPERTIES ØF NIØBIUM	200951
DØKLADY AKAD NAUK SSSR 135, 1399 (1960)	200951
CA 55, 10251 (1961)	200951
KØRNILØV, I	900205
METALLØCHEMISTRY AND SØME ØF ITS PRØBLEMS	900205
AEC-TR-5182	900205
KØRNILØV, I	200769
PHASE-EQUILIBRIUM DIAGRAMS FØR SYSTEMS CØNSISTING ØF GRØUP IV	200769
ELEMENTS AND ØXYGEN	200769
TRUDY KØMISSII ANAL KHIM AKAD NAUK SSSR, INST GEØKHIM I ANAL	200769
KHIM 10, 17 (1960)	200769
CA 55, 7017 (1961)	200769
KØRNILØV, I MATVEEVA, N	201946
METALLØCHEMISTRY ØF VANADIUM	201946
USPE KHIM 31, 1076 (1962)	201946
CA 57, 16271 (1962)	201946
KØRNILØV, I MATVEEVA, N	400588
METALLØCHEMISTRY ØF VANADIUM	400588
TRUDY INST METAL IMENI A A BAYKØVA, METAL,	400588
METALLØV, FIZ, KHIM METØDY ISSLEDØV, 82 (1961)	400588
CA 56, 1247 (1962)	400588
KØRNILØV, I PØLYAKØVA, R	201681
METALLØCHEMISTRY III METALLØCHEMICAL PRØPERTIES ØF NIØBIUM	201681
IZV AKAD NAUK SSR, ØTD KHIM NAUK, 1962, 565	201681
CA 57, 4267 (1962)	201681
KØRNILØV, I PØLYAKØVA, R	201242
PRØPERTIES ØF ALLØYS ØF THE TITANIUM-VANADIUM-MØLYBDENUM	201242
SYSTEM	201242
IZVEST AKAD NAUK SSSR ØTDEL TEKH NAUK MET I TØPLIVØ	201242
1961, NØ 4, 76 (1961)	201242
CA 56, 1261 (1962)	201242
KØRNILØV, I VLASØV, V	500126
FUSIØN DIAGRAM ØF THE TITANIUM-VANADIUM-NIØBIUM SYSTEM	500126
ZHUR NEØRG KHIM 2, 2762 (1957)	500126
CA 52, 14497 (1958)	500126
KØRNILØV, N PYLAEVA, E	300508
INVESTIGATIØN ØF EQUILIBRIUM IN THE TERNARY SYSTEM FØRMD BY	300508
NI3NB-NI3TI-NI3TA INTERMETALLICS	300508
IZVFST AKAD NAUK SSSR 25, 197 (1961)	300508
BHT NØ 3, 34 (1961)	300508
KØRNILØV, N PRYAKHINA, L ØZHEMKØVA, Ø SNETKØV, A	300209
INTERACTIØN ØF TITANIUM CARBIDE WITH A SIX-CØMPØNENT NICKEL	300209
SØLID SØLUTIØN	300209

NP-TR-286	300209
NSA 14, 559 (1960)	300209
KORODA, T SUZUKI, T	601326
MELTING POINT, TRANSITION POINTS AND DENSITY OF	601326
METALLIC URANIUM	601326
DENKI SHAKENSKO IH0 22, 509 (1958)	601326
NSA 14, 22050 (1960)	601326
KOROLEV, L MOROZOV, A	301273
(POLYTECH INST CHELYABINSK USSR)	301273
FORMATION OF VANADIUM NITRIDE IN LIQUID IRON	301273
IZV VYSSHIKH UCHEBN ZAVEDENII CHERNAYA MET 6, NO 4, 45 (1963)	301273
CA 59, 2443 (1963)	301273
KOROLEV, L MOROZOV, A	301272
EQUILIBRIUM OF NITROGEN AND VANADIUM IN GAMMA-IRON	301272
IZV VYS UCHEB ZAV CHERN MET 5 NO 9, 39 (1962)	301272
RUSS ACC 15, NO 10, 2774 (1963)	301272
KOROLEV, F OSIPOV, Y	601321
(LOMONOSOV MOSCOW STATE UNIV MOSCOW RUSSIA)	601321
RESULTS OF INVESTIGATION OF ISOTOPIC SHIFT IN THE	601321
SPECTRUM OF ND	601321
DOKLADY AKAU NAUK SSSR 110, 365 (1956)	601321
NSA 11, 3212 (1957)	601321
KOROLKOV, A IGUMNOVA, A	300538
SURFACE TENSION OF INTERMETALLIC COMPOUNDS	300538
IZV AKAU NAUK SSSR OTD TEH NAUK MET I TOPLIVO NO 6, 95	300538
(1961)	300538
BHT NO 2, 34 (1962)	300538
KOROSTYLEVA, L	601096
ISOTOPIC SHIFT IN THE SPECTRUM OF CERIUM	601096
OPTIKA I SPEKTROSKOPIYA 3, 536 (1957)	601096
CA 52, 8723 (1958)	601096
KORSUNSKII, M GENKIN, Y	301274
(POLYTECH INST KHARKOV RUSSIA)	301274
X-RAY SPECTRA OF NI0BIUM IN THE NI0BIUM-NITROGEN SYSTEM IN THE	301274
REGION OF THE ALPHA PHASE	301274
IZV AKAU SSSR SER FIZ 27, 362 (1963)	301274
CA 59, 4694 (1963)	301274
KORSUNSKII, M GENKIN, Y	201274
THE X-RAY SPECTRA OF PURE NI0BIUM AND	201274
ITS DI0XIDE, NITRIDE AND CARBIDE, THE TYPE OF BONDING IN	201274
THESE COMPOUNDS	201274
ISSLED0VANIYA PO ZHAR0PROCH SPIAVAN, AKAU NAUK SSSR	201274
INST MET IM AA BAIKOVA 6, 169 (1960)	201274
CA 56, 3028 (1962)	201274
KORSUNSKII, M GENKIN, Y VERKHOGLYADOL, T	300912
(VI LENIN POLYTECH INST KHARKOV RUSSIA)	300912
CORRECTED (BETA-2) EMISSION BANDS OF NI0BIUM AND BOND FORCES	300912
IN THE NI0BIUM-NITROGEN SYSTEM	300912
POROSHKOVAYA MET AKAU NAUK UKR SSR 2, NO 4, 35 (1962)	300912
CA 58, 145(1963)	300912
KOSENKO, V IGNATKOV, V	201209
(PHYS INST KIEV RUSSIA)	201209
EVAPORATION OF GERMANIUM IN TELLURIUM VAPOR	201209

FIZ TVERDAGØ TELA 3, 89 (1961)	201209
CA 56, 951 (1962)	201209
KØSENKØ, V NESTERENKØ, B	600847
EVAPØRATION ØF SI IN TE VAPØRS	600847
FIZ TVERDØGØ TELA 3, 660 (1961)	600847
CA 55, 20550 (1961)	600847
KØSØLAPØVA, T SAMSONØV, G	300918
CHEMICAL PRØPERTIES AND METHØDS ØF ANALYSIS ØF	300918
CHROMIUM CARBIDES	300918
FTD-TT-62-1825	300918
TRUDY INSTITUT METALL I SPET SPLAVØV SEMINAR PØ ZHAR	300918
MATERIALAM NØ 6, 38 (1960)	300918
CØTS NØ 60, 84 (1962)	300918
KØSØLAPØVA, T KUGAY, L	300917
CHEMICAL PRØPERTIES AND METHØDS ØF ANALYZING SOME SILICIDES	300917
FTD-TT-62-1825	300917
TRUDY INSTITUT METALL I SPET SPLAVØV SEMINAR PØ ZHAP	300917
MATERIALAM NØ 6, 69 (1960)	300917
CØTS NØ 60, 84 (1962)	300917
KØSØLAPØVA, T SAMSONØV, G	200957
(INST METAALLØCERAM AND SPEC ALLOYS KIEV)	200957
KINETICS ØF THE ØXIDATION ØF CHROMIUM CARBIDES	200957
ZHUR FIZ KHIM 35, 363 (1961)	200957
CA 55, 11036 (1961)	200957
KØSØLAPØVA, T SAMSONØV, G	301275
CHEMICAL PRØPERTIES AND METHØDS ØF ANALYZING CHROMIUM CARBIDES	301275
TRUDY AK NAUK UKRAYIN RSR INST METALL I SPETSIALNYKH SPLAVØV	301275
SEMINAR PØ ZHARØSTØYKIM MATERIALAM	301275
CØTS 66, 131 (1963)	301275
KØSØLAPØVA, T SAMSONØV, G	300925
ØN THE CHEMICAL STABILITY ØF CHROMIUM CARBIDES	300925
UKR KHIM ZH 28, 931 (1962)	300925
KØSUGE, K TAKADA, T KACHI, S	301276
(KYØTØ UNIV JAPAN)	301276
PHASE EQUILIBRIA THE PHASE DIAGRAM ØF THE V2Ø3-V2Ø5 SYSTEM AND	301276
ITS MAGNETISM	301276
NIPPØN KAGAKU ZASSHI 83, 1243 (1962)	301276
BHT NØ 2, 39 (1963)	301276
KØSØV, N RIVIN, Ø	400590
NEW TYPE ØF CALØRIMETER FØR DETERMINING THERMAL CØNSTANTS	400590
TEZISY ØØKLADØV I SØØBUSHCHENIY NA	400590
SØVESHCHANII PØ TEPLØ-I MASSØØBMENU MINSK, AK NAUK BELØRUSSKØY	400590
SSR (1961)	400590
FTD-TT-62-59	400590
KØTSCH, H	301509
(WISS Z TECH UNIV DRESDEN GERMANY)	301509
CHROMIUM BØRIDE-BASE SINTERED ALLOYS	301509
CA 58, 11041 (1963)	301509
KØVALCHENKØ, M NESHØØR, V SAMSONØV, G	700869
PREPARATION ØF LANTHANUM CARBIDE	700869
ZHUR PRIKLAD KHIM 31, 1427 (1958)	700869
CA 53, 953 (1959)	700869

KOVALCHENKO, M. SAMSONOV, G	300193
ALLOYS OF ZIRCONIUM BORIDE WITH MOLYBDENUM	300193
VOPROSY POROSHKOVOI MET I PROCHNOSTI MATERIALOV AKAD NAUK UKR	300193
SSR NO 7 18 (1959)	300193
CA 55, 19713 (1961)	300193
KOVALCHENKO, M. SAMSONOV, G	201472
THE NBC-C SECTION IN THE NIOBIUM-CARBON SYSTEM	201472
DOPVIDI AKAD NAUK UKR RSR 1961, NO 11, 1478 (1961)	201472
CA 56, 11328 (1962)	201472
KOVALCHENKO, M. SAMSONOV, G	300920
VISCIOUS FLOW DURING HOT PRESS SINTERING OF POWDERS	300920
ISSLED PO ZHAROPROACH SPLAVAM, AKAD. NAUK SSSR INST MET 8,	300920
116 (1962)	300920
CA 58, 328 (1963)	300920
KOVALSKII, A. VRZESHCH, F	201131
MUTUAL SOLUBILITY OF ISOMORPHIC HIGH-MELTING-POINT	201131
CARBIDES WITH CUBIC CRYSTAL LATTICE (X-RAY ANALYSIS)	201131
SBORNIK TRUDOV VSESOUZ NAUCH-ISSLEDOVATEL INST	201131
TVERD SPLAVOV 1, 305 (1959)	201131
CA 55, 19660 (1961)	201131
KOVALSKII, A. SEMENOVSKAYA, S	201671
(ALL-UNION SCI-RES INST SOLID ALLOYS)	201671
STRUCTURE OF MOLYBDENUM MONOCARBIDE	201671
KRISTALLOGRAFIYA 4, 923 (1959)	201671
CA 57, 4128 (1962)	201671
KOVRA, L. M. TRUNOV, V. K.	301278
NIOBIUM OXIDE	301278
DOKL AN SSSR 147 3, 622 62	301278
RUSS ACC VOL 15, 12 3268 MARCH 1963	301278
KOVTUN, G. KRUGLUKH, A. POVLIOV, V.	300733
(PHYS TECH INST KHARKOV KHARKOV RUSSIA)	300733
DETERMINATION OF THE VAPOR PRESSURE OF METALS FROM	300733
THE RATE OF VAPORIZATION	300733
UKRAIN FIZ ZHUR 6, 386 (1961)	300733
CA 57, 2871 (1962)	300733
KOVALCHENKO, M. SAMSONOV, G. YASINSKAYA, G.	201044
MELTS OF BORIDES OF TRANSITION METALS WITH OTHER METALS	201044
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK MET I TOPLIVO 1960, NO 2,	201044
115 (1960)	201044
CA 55, 14259 (1961)	201044
KOZLOVSKAYA, V.	301103
MASS SPECTROMETER DETERMINATION OF THE AMOUNT AND COMPOSITION	301103
OF GASES ADSORBED ON THE SURFACE OF GERMANIUM AND SILICON	301103
MONOCRYSTALS	301103
RUSSIAN BOOK OPREDELENIE KOLICHESTVA I SOSTAVA GAZOV	301103
ADSORBIROVANNYKH NA POVERKHNOSTI MONOKRISTALLOV	301103
GERMANIYA I KREMNIYA MASS SPEKTROMETRICHESKIM METODOM	301103
COTS 54, 249 (1962)	301103
KOZAKEVITCH, P. URBAIN, G.	201557
SURFACE TENSION OF MOLTEN ALLOYS. III. ELEMENTS OF GROUPS	201557
V (IN, P, AS, SB, V), IV (C, SI, SN, ZR), AND III (B, AL, LA,	201557
CE)	201557
MEM SCI REV MET 58, 931 (1961)	201557
CA 56, 15265 (1962)	201557

KØZAKFVITCH, P	URBAIN, G	201558
(INST RECH SIDERURGIE	SFINF-ET-ØISE	FRANCE)
THE SURFACE TENSION OF LIQUID PLATINUM AT 1800 DEGREES		201558
CØMPT REND 253, 2229 (1961)		201558
CA 57, 76 (1962)		201558
KØZHEVNIKØV, G		301510
REDUCTION OF ØXIDES OF BARIUM AND STRØNTIUM WITH ALUMINUM		301510
TSVETN METAL 36(2), 53 (1963)		301510
CA 59, 3602 (1963)		301510
KØZMANØV, Y		201005
SOLID-STATE REACTION BETWEEN IRØN ØXIDE AND THE DIOXIDES OF		201005
MØLYBDENUM AND TUNGSTEN		201005
ZHUR NEØRG KHIM 5, 2048 (1960)		201005
CA 55, 13148 (1961)		201005
KØZMANØV, Y	FESHCHUKØVA, T	201589
HIGH TEMPERATURE ØXIDATION OF ALLOYS OF TUNGSTEN AND RHENIUM		201589
TR URAL SK PØLITEKHN INST SB 114, 120 (1961)		201589
CA 57, 557 (1962)		201589
KRAEV, M		300798
ANALYTICAL WAVE FUNCTION AND ENERGY VALUE OF THE		300798
GROUND STATE BØRØN ATØM		300798
IZV FIZ INST ANEB (BULGARIA) AKAD NAUK 9, NØ 1, 137 (1961)		300798
PA 65, 6080 (1962)		300798
CA 56, 8167 (1962)		300798
KRAFTMAKHER, Y A		301279
VACANCY FØRMATION IN NB		301279
FIZ TVERD TELA 5, 950 (1963)		301279
BHT 2, 7 (1963)		301279
KRAFTMAKHER, I A	STRELKØV, P G	301280
CRYSTAL LATTICES		301280
FIZ TVER TELA 4 8, 2271 62		301280
RUSS ACC 15, 11 2880 (1963)		301280
KRAFTMAKHER, I A		301281
THE MØDULATION METHØD FØR HEAT CAPACITY		301281
PMTF 5, 176 (1962)		301281
RUSS ACC VØL 16, 1, 151 (1963)		301281
KRAFTMAKHER, I A		301282
HEAT CAPACITY OF TANTALUM AT 1200-2900 DEGREES		301282
ZH PRIKL MEKHAN I TEKHN FIZ 1963 2, 158 (1963)		301282
CA 59, 3370H (1963)		301282
KRAMER, D	RHØDES, C	201367
(IN AM AVIATION INC	CANØGA PARK	CALIF)
GAMMA TO GAMMA-PRIME TRANSFORMATION IN THE		201367
URANIUM-MØLYBDENUM SYSTEM		201367
U S AT ENERGY CØMM NAA-SR-6617, (1961)		201367
CA 56, 7018 (1962)		201367
KRASØVITSKAYA, R	KANTØR, P	KAN, I
KANDYBA, V	KUTSINA, L	
FØMITCHEV, E		300336
DETERMINATION OF THE ENTHALPY AND HEAT CAPACITY OF BØRØN		300336
ØXIDE 5203 FRØM 1000 TO 2200 DEG K		300336
ØAKLADY AKAD NAUK SSSR 139, 1499 (1961)		300336
BHT 4, 25 (1961)		300336

KRASOVITSKAYA, R	KANTOR, P	KAN, I	KANDYBA, V	KUTSYNA, L	700968
FOMITCHEV, E					700968
(INST OF STANDARDS AND MEASURING INSTRUMENTS				USSR)	700968
DETERMINATION OF ENTHALPY AND HEAT CAPACITY OF B2O3 FROM					700968
1000 TO 2200 DEGREES K					700968
ZHUR FIZ KHIM 35, 1499 (1961)					700968
NSA 15, 32176 (1961)					700968
KRAUSS, F					700647
(UNIV COLOGNE				GERMANY)	700647
THE MEASUREMENT OF SPECIFIC HEAT OF METALS AT HIGH					700647
TEMPERATURES					700647
Z METALLK 49, 386 (1958)					700647
CA 52, 16150					700647
KREBS, K					202082
RENORMALIZATION EFFECT IN THE ELECTRONIC SPECIFIC HEAT OF					202082
VANADIUM					202082
PHYS LETTERS 6, 31 (1963)					202082
KREBS, K	NELKOWSKI, H				601029
(TECH UNIV		BERLIN		GERMANY)	601029
ISOTROPIC DISPLACEMENT IN THE RESONANCE LINES OF YB11 AND IN					601029
THE SINGLET SYSTEM OF YBI					601029
Z PHYSIK 145, 543 (1956)					601029
CA 50, 16371 (1956)					601029
KREIMER, G	VAKHOVSKAYA, M				300213
VARIATION OF THE SIZE AND SHAPE OF GRAINS OF TiC-WC SOLID					300213
SOLUTIONS DURING HEATING IN THE PRESENCE OF FREE WC WITH AND					300213
WITHOUT COBALT					300213
SBORNIK TRUDOV VSESoyUZ NAUK-INSLEDZAVATIL INST TVERD SPPLAVOV					300213
1, 205 (1959)					300213
CA 55, 19660 (1961)					300213
KRENTSIS, R	GELD, P	SEREBRENNIKOV, N			300195
ENTHALPY OF CHROMIUM-BEARING IRON ALLOYS AT HIGH TEMPERATURES					300195
IZV VUZ CHERNAYA MET, 5 (1960)					300195
ASM REVIEW OF MET LIT 18, NO 9 35 (1961)					300195
KRESTOV, G A					301283
CONCERNING PARTIAL MOLAL QUANTITIES					301283
ZH FIZ KHIM 37, 1406 (1963)					301283
KRESTOVNIKOV, A	VIGDOROVICH, V				301512
RELATION BETWEEN THE MELTING POINT OF ELEMENTS AND THE					301512
SHORTEST INTERATOMIC DISTANCE IN THEIR CRYSTAL LATTICES					301512
SB NAUCHN TR INST TSVEIN MET IM M I KATININA 33, 421 (1960)					301512
CA 58, 13158 (1963)					301512
KRESTOVNIKOV, A					300930
APPROXIMATE METHODS OF CALCULATING ENTHALPY OF METALLURGICAL					300930
REACTIONS OF RARE METALS					300930
RAZDELENIE BLIZKIKH PO SVOSTAM REDK. I METAL 1962, 255 (1962)					300930
CA 58, 980 (1963)					300930
KRESTOVNIKOV, A	LOMOV, A				300927
THERMODYNAMICS OF REDUCTION OF TITANIUM OXIDES					300927
SB NAUCHN TR INST TSVEIN METAL 1960, NO 33, 8 (1960)					300927
CA 57, 14497 (1962)					300927
KRESTOVNIKOV, A	VENDRIKH, M				200783

THERMODYNAMICS OF TITANIUM CHLORIDE	200783
IZVEST VYSSHIKH UCHEB ZAVEDENII, TSVETNAYA MET 2, NO 2 54	200783
(1959)	200783
CA 55, 91 (1961)	200783
KRESTOVNIKOV, A VENDRIKH, M	200797
(INST NON-FERROUS METLS, GOLD MOSCOW USSR)	200797
HEAT CAPACITY OF CHROMIUM BORIDE	200797
CHISTYE METAL I POLUPROVOD, TRUDY 1-01 (PERV01) MEZHVUZ	200797
KONF, MOSCOW 1957, 165 (1959)	200797
CA 55, 1168 (1961)	200797
KRESTOVNIKOV, A VENDRIKH, M	300672
THERMODYNAMICS OF MAKING TITANIUM AND CHROMIUM	300672
DIBORIDES BY THE BORON CARBIDE METHOD	300672
SBOR NAUCH TRUD GINTSVETMET NO 33, 3 (1960)	300672
RUSS ACC 15, NO 3, 708 (1962)	300672
KRIEGER, F	300931
(RAND CORP SANTA MONICA CAL)	300931
THE THERMODYNAMICS OF THE GRAPHITE-CARBON VAPOR SYSTEM	300931
AD 285973	300931
TAB 63, 1, 2, 107 (1963)	300931
KRIEVE, W MASON, D	300290
MEASUREMENT OF EQUILIBRIUM OF THE REACTION $TiCl_3(s) + HCl(g)$	300290
$= TiCl_4(g) + 1/2 H_2(g)$	300290
J CHEM PHYS 25, 524 (1956)	300290
KRIKORIAN, N WITTEMAN, W BOWMAN, M	200956
(LOS ALAMOS SCI LAB LOS ALAMOS N MEXICO)	200956
THE PREPARATION, CRYSTAL STRUCTURES, AND SOME PROPERTIES OF	200956
ZIRCONIUM AND HAFNIUM DIRHENIDE	200956
J PHYS CHEM 64, 1517 (1960)	200956
CA 55, 11020 (1961)	200956
KRIKORIAN, N H WALLACE, T C ANDERSON, J L	202083
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	202083
LOW TEMPERATURE THERMAL EXPANSION OF THE GROUP 4A	202083
CARBIDES	202083
J ELECTROCHEM SOC 110, 587 (1963)	202083
KRIKORIAN, N H WALLACE, T C ANDERSON, J L	301285
LOW-TEMPERATURE THERMAL EXPANSION OF THE GROUP IV A CARBIDES	301285
J ELECTROCHEM SOC 110, 587 (1963)	301285
CA 59, 2188F (1963)	301285
KRIKORIAN, N WITTEMAN, W BOWMAN, M	301513
(LOS ALAMOS SCI LAB LOS ALAMOS N MEXICO)	301513
THE MUTUAL SOLID SOLUBILITY OF HAFNIUM CARBIDE AND URANIUM	301513
MONOCARBIDE	301513
J ELECTROCHEM SOC 110, 560 (1963)	301513
CA 58, 13191 (1963)	301513
KRIKORIAN, O H	301284
THE VAPOR PRESSURE OF SCANDIUM METAL	301284
J PHYS CHEM 67, 1586 (1963)	301284
KRIKORIAN, O	301111
ESTIMATION OF HIGH-TEMPERATURE HEAT CAPACITIES OF CARBIDES	301111
US AT ENERGY COMM UCRL-6785 (1962)	301111
CA 57, 5367 (1962)	301111

KRIKORIAN, O		700847
(UNIV LIVERMORE LAWRENCE RADIATION LAB	CALIFORNIA)	700847
THERMAL EXPANSION OF HIGH TEMPERATURE MATERIALS		700847
USAEC - UCRL - 6132 (1960)		700847
CA 55, 4078 (1961)		700847
NSA 15, 1832 (1961)		700847
KRIPYAKEVICH, P		600698
THE ALPHA-MN AND BETA-MN STRUCTURES		600698
KRISTALLOGRAFIYA 5, 273 (1960)		600698
SOVIET PHYSICS CRYSTALLOGRAPHY 5, 253 (1960)		600698
PA 64, 4040 (1961)		600698
KRIPYAKEVICH, P EVDOKIMENKO, V		201670
(I FRANKO STATE UNIV	LVOV)	201670
CRYSTAL STRUCTURE OF BA2 MG17 AND SR2 MG17		201670
KRISTALLOGRAFIYA 7, 31 (1962)		201670
CA 57, 4127 (1962)		201670
KRIPYAKEVICH, P GLADYSHEVSKII, E		201822
(I FRANKO STATE UNIV	LVOV POLAND)	201822
CRYSTAL STRUCTURE OF COMPOUNDS IN THE SYSTEMS NO-AL, Y-AL, AND		201822
GD-FF		201822
KRISTALLOGRAFIYA 6, 118 (1961)		201822
CA 57, 10606 (1962)		201822
KRIPYAKEVICH, P TYLKINA, M SAVITSKII, E		201377
(STATE UNIV	LVOV POLAND)	201377
THE CRYSTAL STRUCTURES AND SOME PROPERTIES OF COMPOUNDS OF		201377
HAFNIUM WITH BERYLLIUM		201377
ZHUR STRUKT KHIM 2, 424 (1961)		201377
CA 56, 8102 (1962)		201377
KRISHMAN, K JAIN, S		601281
(NATL PHYSICAL LAB	NEW DELHI INDIA)	601281
DETERMINATION OF THERMAL CONDUCTIVITY AT HIGH TEMP		601281
BRIT J APPL PHYS 5, 426 (1954)		601281
NSA 9, 1564 (1955)		601281
KRISHNA, P VERMA, A R		301287
(BANARAS HINDU UNIV	VARANASI INDIA)	301287
ANOMALIES IN SILICON CARBIDE POLYTYPES		301287
PROC ROY SOC 272A, 490 (1963)		301287
BHT NO 2, 16 (1963)		301287
KRISHNA, P VERMA, A R		202084
(BANARAS HINDU UNIV	VARANASI INDIA)	202084
ANOMALIES IN SILICON CARBIDE POLYTYPES		202084
PROC ROY SOC (LONDON) SER A 272, 490 (1963)		202084
CA 58, 9696F (1963)		202084
KRISHNA, P VERMA, A		701058
(BANARAS HINDU UNIV	VARANASI INDIA)	701058
A NEW POLY-TYPE OF SILICON CARBIDE-57F ITS STRUCTURE AND		701058
GROWTH		701058
NP-10247		701058
ACTA CRYST 15, 383 (1962)		701058
NSA 15, 26698 (1961)		701058
KRIVSKY, W SCHUHMAN, R		300459
DERIVATION OF PHASE DIAGRAM FOR THE SILICON-OXYGEN-CARBON		300459
SYSTEM		300459
TRANS AIME 221, 898 (1961)		300459

BHTG NO 4, 4 (1962)	300459
KRØGH-MØE, J	301288
(SVENSKA SILIKATFÖRSKNINGSIN GÖTEBORG SWEDEN)	301288
ENERGY AND LENGTH OF THE BORON-OXYGEN BOND	301288
ACTA CHEM SCAND 17, 843 (1963)	301288
CA 59, 4556A (1963)	301288
KRUPKA, M	601598
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	601598
HIGH TEMPERATURE VAPORIZATION BEHAVIOR AND	601598
THERMODYNAMIC PROPERTIES OF HAFNIUM DIBORIDE	601598
LA-2611 (1962)	601598
NSA 16, 16722 (1962)	601598
KRUPNIKOV, K BAKANOVA, A BRAZNIK, M TRUNIN, R	301149
AN INVESTIGATION OF THE IMPACT COMPRESSIBILITY OF TI, MO, TA	301149
AND FE	301149
DOKL AKAD NAUK SSSR 148, (6) 1302 (1963)	301149
BHT NO 1, 9 (1963)	301149
KSENOFONTOVA, R VASILEVA, I GERASIMOV, Y	301388
(MOSCOW UNIV MOSCOW USSR)	301388
THERMODYNAMICS OF TUNGSTEN OXIDES OF VARIABLE COMPOSITION	301388
DOKLADY AKAD NAUK SSSR 143, 1105 (1962)	301388
NSA 16, 21055 (1962)	301388
KUBASCHEWSKI, Ø	600792
APPLICATION OF CHEMICAL THERMODYNAMICS TO PRACTICAL PROBLEMS	600792
TRANS BRIT CERAM SOC 60, 67 (1961)	600792
CA 55, 14042 (1961)	600792
KUBASCHEWSKI, Ø	601577
(GT BRIT NAT PHYS LAB TEDDINGTON ENGLAND)	601577
THE THERMOCHEMISTRY AND KINETICS OF OXIDATION	601577
OF GROUPS IVA AND VA TRANSITION METALS	601577
NP-11056	601577
NSA 16, 4495 (1962)	601577
KUBASCHEWSKI, Ø CATTERALL, J	601642
THERMOCHEMICAL DATA OF ALLOYS	601642
PERGAMON PRESS (1956)	601642
KUBASCHEWSKI, Ø DENCH, W HEYMER, G	300211
THERMODYNAMICS OF THE SYSTEM CHROMIUM-NICKEL	300211
ZEITSCHRIFT FÜR ELEKTROCHEMIE 64, 801 (1960)	300211
ASM REV 18, NO 2, 30 (1961)	300211
KUBASCHEWSKI, Ø EVANS, E	700829
METALLURGICAL THERMOCHEMISTRY	700829
BUTTERWORTH-SPRINGER, LONDON (1956)	700829
KUBASCHEWSKI, Ø HEYMER, G	600696
THE THERMODYNAMICS OF THE CHROMIUM-IRON SYSTEM	600696
ACTA METAL 8, 416 (1960)	600696
PA 64, 2539 (1961)	600696
KUBASCHEWSKI, Ø HOPKINS, B	201038
(NATL PHYS LAB TEDDINGTON ENGLAND)	201038
OXIDATION MECHANISMS OF NIOBIUM, TANTALUM, MOLYBDENUM, AND	201038
TUNGSTEN	201038
J LESS COMMON METALS 2, 172 (1960)	201038
CA 55, 14236 (1961)	201038

KUBO, K SHINRIKI, K	201210
(TOKYO INST TECHNOL TOKYO JAPAN)	201210
THE REACTION MECHANISM OF FORMATION OF TITANIUM CARBIDE	201210
UNDER VACUUM	201210
KOGYO KAGAKU ZASSHI 63, 64 (1960)	201210
CA 56, 983 (1962)	201210
KUBO, T HANAZAWA, T	201428
(TOKYO INST TECHNOL TOKYO JAPAN)	201428
PREPARATION OF TITANIUM BORIDE	201428
KOGYO KAGAKU ZASSHI 63, 1144 (1960)	201428
CA 56, 9685 (1962)	201428
KUBO, T SHINRIKI, K HANAZAWA, T	201691
(TOKYO INST TECHNOL)	201691
REACTION OF TITANIUM SUBOXIDE WITH CARBON BLACK	201691
KOGYO KAGAKU ZASSHI 64, 619 (1961)	201691
CA 57, 4291 (1962)	201691
KUBOTA, B	700586
DECOMPOSITION OF HIGHER OXIDES OF CHROMIUM UNDER VARIOUS	700586
PRESSURES OF OXYGEN	700586
J AM CERAM SOC 44, 239 (1961)	700586
KUROTA, T	600910
PREPARATION OF FERROMAGNETIC CHROMIUM DIOXIDE	600910
J PHYS SOC 15, 1706 (1960)	600910
CA 55, 12129 (1961)	600910
KUCHEROV, R RIKENGLAZ, L	300154
THE PROBLEM OF MEASURING THE CONDENSATION COEFFICIENT	300154
DOKLADY AKAU NAUK SSSR PHYS CHEM SECT 133, 1130 (1960)	300154
KUDINSTEVA, G EPELBAUM, V TSAREV, B	601182
SYNTHESIS OF HEXABORIDES OF SOME RARE EARTH METALS AND	601182
THEIR ELECTRON-EMISSION PROPERTIES	601182
BOR TRUDY KONE KHIM BORA I YEG SOYEDINENII 1955, 112 (1956)	601182
CA 54, 12780 (1960)	601182
KUDINTSEVA, G NEKHOR, V SAMSONOV, G TSAREV, G	301514
PADERNO, Y	301514
THERMO-EMITTING PROPERTIES OF THE BORIDES OF SCANDIUM	301514
AND GADOLINIUM	301514
VYSOKOTEMPERATURNYE METALLOKRAM MATERIALY, AKAU NAUK	301514
UKR SSR, INST METALLOKRAM I SPETS SPLAVOV 109 (1962)	301514
CA 58, 7468 (1963)	301514
KUDINTSEVA, G A POPOV, V K	301289
PROCESSING LANTHANUM BORIDE WITH A PLASMA JET	301289
POROSHKOVAYA MET AKAU NAUK UKR SSR 2, 4, 56 (1962)	301289
CA 58, 267H (1963)	301289
KUDINTSEVA, G TSAREV, B	900214
THE BORIDES OF THE TRANSITION METALS, D THEIR	900214
ELECTRON-EMISSION PROPERTIES	900214
TRUDY KONE PO KHIM BORA I YEG SOYEDINENII 1958, 106 (1958)	900214
FTD-TT-62-1506	900214
KUDINTSEVA, G POLYAKOVA, M SAMSONOV, G TSAREV, B	700737
PREPARATION AND SOME PROPERTIES OF THE HEXABORIDE OF YTTRIUM	700737
FIZ METAL I METALLOVED 6, 272 (1956)	700737
CA 53, 9871 (1959)	700737

KUDRYAVTSEV, B	300363
CALCULATION OF THE CONFIGURATIONAL HEAT CAPACITY OF LIQUIDS	300363
ZHUR FIZ KHIM 36, 1117 (1962)	300363
KUDRYAVTSEVA, V SØFRØNØV, G	600789
PRECISION LATTICE-PARAMETER DETERMINATION OF BØRØN CARBIDE	600789
OF COMPOSITIONS B2.75C TO B6.75C BY X-RAY EXPOSURES ØBTAINED	600789
IN THE REGION OF LARGE-ANGLE SCATTERING (0-90 DEG)	600789
TRUDY SEMINARA PØ ZHARØSTØIKIM MATERIALAM AKAD NAUK UKR	600789
SSR- INST METALLØKERAM I SPETSIAL SPLAVØV KIEV 1958,	600789
NØ. 5 52 (1960)	600789
CA 55, 14003 (1961)	600789
KUHLBØRG, L	301498
(UNIV OF UPPSALA UPPSALA SWEDEN)	301498
THE CRYSTAL CHEMISTRY OF MØLYBDENUM ØXIDES	301498
ADVAN CHEM SER 39, 37 (1963)	301498
CA 58, 13236 (1963)	301498
KUHLMAN, C	201904
(MALLINCKRØDT CHEM WØRKS ST LØUIS MØ)	201904
REDUCTION OF URANIUM TRIØXIDE TO URANIUM DIØXIDE WITH HYDRØGEN	201904
REACTION RATES AT VARIOUS TEMPERATURES	201904
US AT ENERGY CØMM MCW-142, (1948)	201904
CA 57, 14470 (1962)	201904
KUHLMAN, C	201115
(MALLINCKRØDT CHEM WØRKS ST LØUIS MØ)	201115
FLUØRINATION OF URANIUM DIØXIDE WITH HYDRØGEN FLUØRIDE WATER	201115
MIXTURES	201115
US AT ENERGY CØMM MCW-138 (1948)	201115
CA 55, 18409 (1961)	201115
KUHLMAN, C	201105
(MALLINCKRØDT CHEM WØRKS ST LØUIS MØ)	201105
FLUØRINATION OF URANIUM TRIØXIDE, RATE AND APPARENT EQUILIBRIUM	201105
STUDIES	201105
US AT ENERGY CØMM MCW 144 (1948)	201105
CA 55, 18257 (1961)	201105
KULESHØV, I SADIKØV, G SØKØLØVA, Z	300770
NEUTRØNØGRAPHIC STUDY OF HIGH TEMPERATURE BERYLLIUM ØXIDE	300770
ZHUR FIZ KHIM 36, 1369 (1962)	300770
CA 57, 8012 (1962)	300770
KULVARSKAYA, B MASLØVSKAYA, R	300399
THERMIØNIC EMISSION AND VAPØR PRESSURE OF RARE EARTH METAL	300399
ØXIDES	300399
RADIØTEKH I ELEKTRØN 5, 1254 (1960)	300399
CA 55, 25475 (1961)	300399
KUHN, W	300919
FØRMATION OF SILICON CARBIDE IN THE ELECTRIC ARC	300919
J ELECTROCHEM SØC 110, NØ 4, 298 (1963)	300919
KUPRØVSKII, B GELD, P	201867
THERMAL CØDUCTIVITY OF ALPHA-TITANIUM	201867
TR URALSK PØLITEKHN INST SB NØ 114, 153-4 (1961)	201867
CA 57, 12229 (1962)	201867
KURNAKØV, N TRØNEVA, M	601588
EQUILIBRIUM DIAGRAM OF THE BINARY SYSTEM	601588

OF TI-C WITH UP TO 5 PERCENT CARBON	601588
ZHUR NEORG KHIM 6, 1347 (1961)	601588
NSA 16, 557 (1962)	601588
KUMAR, S	700685
THERMAL EXPANSION OF OXIDES	700685
CENTRAL GLASS AND CERAM RESEARCH INST BULL (INDIA) 7, 58	700685
(1960)	700685
CERAM ABS 44, 199 (1961)	700685
KURNAKOV, N TRONEVA, M	201338
THE TERNARY SYSTEM CR-NB-MO	201338
ZHUR NEORG KHIM 5, 2403 (1960)	201338
CA 56, 5737 (1962)	201338
KURYLENKO, C	201565
TITANIUM II TITANIUM OXIDES	201565
CAHIERS PHYS NO 92, 163 (1958)	201565
CA 57, 163 (1962)	201565
KUSAMICHI, H YAGI, Y YUKAWA, T	201494
(KOBEL STEEL WORKS LTD)	201494
COMMERCIAL HIGH PURITY TITANIUM AND TITANIUM ALLOYS	201494
NIPPON KINZOKU GAKKAISHI 21, (1957)	201494
CA 56, 12624 (1962)	201494
KUSENKO, F GELD, P	300252
HEAT OF FORMATION OF NIOBIUM PENTOXIDE	300252
ZHUR OSHCHE KHIM 30, NO 11 3847 (1960)	300252
J GEN CHEM 30, 3806 (1960)	300252
CA 55, 18278 (1961)	300252
KUSENKO, F GELD, P	200823
PROPERTIES OF NIOBIUM DIOXIDE	200823
IZVEST VYSSHIKH UCHEB ZAVEDENII, TSVETNAYA MET 3, NO 4, 102	200823
(1960)	200823
CA 55, 3141 (1961)	200823
KUSENKO, F GELD, P	300727
SPECIFIC HEAT AND VARIATION OF ISOTHERMAL-ISOBARIC POTENTIAL	300727
(FREE ENERGY) IN THE FORMATION OF Nb ₂ O ₅	300727
TRUDY URALSK POLITEKHNI INST IM SM KIROVA 1959, NO 92, 121	300727
(1959)	300727
CA 57, 2930 (1962)	300727
KUSENKO, F GELD, P	300929
THERMOCHEMISTRY OF NIOBIUM OXIDES AND CARBIDES	300929
FIZ KHIM OSNOVY PROIZV STALI AKAD NAUK SSSR	300929
INST MET TR FIFTH CONF 1959, 41 (1961)	300929
CA 58, 1955 (1963)	300929
KUSENKO, F GELD, P	700619
NIOBIUM-CARBON-OXYGEN SYSTEM EQUILIBRIUMS	700619
IZVEST VYSSHIKH UCHEB ZAVEDENII TSVETNAYA MET 4, 43 (1961)	700619
CT NO 12, (1961)	700619
CA 55, 18486 (1961)	700619
KUSENKO, F GELD, P	701007
HEATS OF FORMATION OF NIOBIUM OXIDES AND CARBIDES	701007
IZVEST AKAD NAUK SSSR SIBIR OTDEL 1960, NO 2, 46 (1960)	701007
AEC-TR-4362	701007
NSA 15, 9440 (1961)	701007

KUTSEV, V METHODS OF CALCULATING THE ACTIVITY OF CARBON IN AUSTENITES ZHUR FIZ KHIM 36, 849 (1962)	300358 300358 300358
KUTSEV, V ORMONT, B EQUILIBRIUM INVESTIGATION IN THE REDUCTION REACTION OF TITANIUM DIOXIDE WITH CARBON AT HIGH TEMPERATURES ZHUR FIZ KHIM 29, 597 (1955)	300153 300153 300153 300153
KUTSEV, V SMAGINA, E MÖRZHEEDOVA, R THE B-FORM OF THE OXIDE SM2O3 ZH NEÖRGAN KHIM 8, 1049 (1963) CF CA 51, 14447C CA 59, 3513 (1963)	301515 301515 301515 301515
KUTYRKIN, V PEIZULAEV, S TUNITSKII, L BERYLLIUM FLUORIDE SPECTRUM FIZ SBÖRNIK LVÖV UNIV 1957, NÖ 3, 486 (1957) CA 56, 109 (1962)	201203 201203 201203 201203
KUZMIN, A PALATNIK, L VAPÖR PRESSURE OF TITANIUM ÖVER TITANIUM-MÖLYBDENUM ALLÖYS FIZ METAL I METALLOVED 14, NÖ 5, 795 (1962)	300922 300922 300922
KUZNETSÖV, F BELYI, V REZUKHINA, T GERASIMÖV, Y THERMÖDYNAMIC PROPERTIES OF CERIUM OXIDES DÖKL AKAD NAUK SSSR 139, 1405 (1961) NSA 15, 30564(1961)	300665 300665 300665 300665
KUZNETSÖV, F REZUKHINA, T THERMÖDYNAMIC PROPERTIES OF PRASEÖDYMIUM OXIDES ZHUR FIZ KHIM 36, 1364 (1962)	300627 300627 300627
KUZNETZÖV, F REZUKHINA, T (MÖSCÖW STATE UNIV MÖSCÖW RUSSIA) HEAT CAPACITY OF CERIUM DIOXIDE AT HIGH TEMPERATURE ZHUR FIZ KHIM 34, 2467 (1960) BT 10, 377 (1961) CA 55, 7019 (1961) NSA 15, 7352 (1961)	700537 700537 700537 700537 700537 700537 700537
KUZNETSÖV, F REZUKHINA, T (MÖSCÖW STATE UNIV MÖSCÖW RUSSIA) HEAT CAPACITY OF CERIUM III OXIDE AT HIGH TEMPERATURES ZHUR FIZ KHIM 35, 956 (1961)	700600 700600 700600 700600
KUZNETSÖV, F REZUKHINA, T GÖLUBENKÖ, A (M.V. LÖMÖNÖSÖV STATE UNIV MÖSCÖW RUSSIA) DETERMINATION OF THE HEAT OF FÖRMATION OF CE2O3 BY BÖMB CALÖRIMETRY ZHUR FIZ KHIM 34, 2129 (1960) CA 55, 10039 (1961)	600390 600390 600390 600390 600390 600390
KUZYAKÖV, Y TATEVSKII, V TUNITSKII, L RÖTATIONAL ANALYSIS OF BÖRÖN MÖNÖXIDE BANDS LYING IN THE VACUUM ULTRAVIÖLET REGION ÖPTIKA I SPEKTRÖSKÖPIYA 9, 156 (1960) CA 55, 25461 (1961) PA 64, 2329 (1961)	301065 301065 301065 301065 301065
LACRÖIX, R ÖXIDATION AND EVAPÖRATION OF PLATINUM AT HIGH TEMPERATURES REV MET 53, 809 (1956)	601037 601037 601037

CA 51, 3404 (1957)	601037
LADD, M LEE, W	201322
(BATTERSEA COLL TECHNOL LONDON ENGLAND)	201322
THE LATTICE ENERGIES OF THE ALKALINE EARTH OXIDES AND THE	201322
AFFINITY OF OXYGEN FOR TWO ELECTRONS	201322
ACTA CRYST 13, 959 (1960)	201322
CA 56, 5472 (1962)	201322
LADD, M LEE, W	300575
LATTICE ENERGIES AND CRYSTAL-FIELD STABILIZATION	300575
ENERGIES OF TRANSITION-TYPE METAL COMPOUNDS	300575
J CHEM SOC 2837 (1962)	300575
LADD, M LEE, W	601470
(BATTERSEA COLL OF TECH LONDON ENGLAND)	601470
LATTICE ENERGIES OF COMPOUNDS OF THE TRANSITION TYPE METALS	601470
J INORG NUCLEAR CHEM 23, 199 (1961)	601470
NSA 16, 18892 (1962)	601470
LAFFERTY, J	400541
BORIDE CATHODES	400541
PHYS REV 79, 1012 (1950)	400541
CA 44, 10485 (1950)	400541
LAFFERTY, J	400549
(GENERAL ELEC RESEARCH LAB SCHENECTADY NEW YORK)	400549
BORIDE CATHODES	400549
J APPL PHYS 22, 299 (1951)	400549
CA 45, 4550 (1951)	400549
LAFFITTE, M KURASCHEWSKI, O	700626
ACTIVITIES OF CHROMIUM IN CHROMIUM-MOLYBDENUM SOLID SOLUTIONS	700626
TRANS FARADAY SOC 57, 932 (1961)	700626
CT NO 13, (1961)	700626
LAGERQVIST, A	600925
THE BAND SPECTRUM OF CALCIUM OXIDE IN VIOLET AND	600925
ULTRAVIOLET RANGE	600925
(UNIV STOCKHOLM)	600925
NATURWISSENSCHAFTEN 40, 266 (1953)	600925
CA 48, 443 (1954)	600925
LAGERQVIST, A	301290
THE SPECTRA OF AL ₂ O ₃ AND V ₂ O ₅	301390
MEN SOC REG SCI LIEGE 18, 550 (1957)	301290
CA 51, 16093D (1957)	301290
LAGERQVIST, A	600884
(UNIV STOCKHOLM)	600884
ULTRAVIOLET AND BLUE BANDS OF CALCIUM OXIDE	600884
ARK FYSIK 8, 83 (1954)	600884
CA 48, 11922 (1954)	600884
LAGERQVIST, A ALMKVIST, G	600680
(UNIV STOCKHOLM)	600680
THE ULTRAVIOLET BAND SYSTEM OF STRONTIUM OXIDE	600680
ARKIV FYSIK 8, 481 (1954)	600680
CA 49, 7380 (1955)	600680
LAGERQVIST, A HULDT, L	600681
THE HEIGHT OF THE EXCITED ELECTRON STATES OF CALCIUM,	600681
(UNIV STOCKHOLM)	600681

STRONTIUM AND BARIUM OXIDES	600681
ARKIV FYSIK 8, 427 (1954)	600681
CA 49, 7380 (1955)	600681
LAGERQVIST, A HULDT, L	600765
(UNIV STOCKHOLM)	600765
THE DISSOCIATION ENERGY OF THE GASEOUS OXIDES CR ₂ O AND FE ₂ O	600765
Z NATURFORSCH 8, 493 (1953)	600765
CA 48, 5636 (1954)	600765
LAGERQVIST, A MIESCHER, E	600746
(UNIV BASEL SWITZ)	600746
ABSORPTION SPECTRUM OF THE NITRIC OXIDE MOLECULE	600746
FINE-STRUCTURE ANALYSIS OF THE DELTA- AND BETA-BANDS AND	600746
HOMOGENEOUS PERTURBATION C ₂ PI, B ₂ PI	600746
HELV PHYS ACTA 31, 221 (1958)	600746
CA 52, 19440 (1958)	600746
LAGERQVIST, A NILSSON, N WIGARTZ, K	600702
(UNIV STOCKHOLM)	600702
ROTATIONAL ANALYSIS OF THE BETA-SYSTEM OF B ₂	600702
ARKIV FYSIK 13, 379 (1958)	600702
CA 52, 17948 (1958)	600702
LAGERQVIST, A SELIN, L	300166
ROTATIONAL ANALYSIS OF THE VISIBLE VANADIUM OXIDE BANDS	300166
ARKIV FYSIK 12, 553 (1957)	300166
CA 52, 6923	300166
LAGERQVIST, A SELIN, L	600885
(UNIV STOCKHOLM)	600885
SOME INFRARED BANDS OF VANADIUM OXIDE	600885
ARK FYSIK 11, 429 (1957)	600885
CA 51, 8533 (1957)	600885
LAGERQVIST, A UHLER, U	600923
(UNIV STOCKHOLM)	600923
RED BANDS OF MAGNESIA	600923
NATURE 164, 665 (1949)	600923
CA 44, 3791 (1950)	600923
LAGERQVIST, A UHLER, U	600924
(UNIV STOCKHOLM)	600924
RED AND GREEN BANDS OF MAGNESIA	600924
ARKIV FYSIK 1, 459 (1949)	600924
CA 44, 3791 (1950)	600924
LAINER, D TSYPIN, M	201134
OXIDATION OF TITANIUM AT 300-600 DEGREES	201134
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK MET I	201134
TOPЛИVØ 1961, NO 1, 146 (1961)	201134
CA 55, 19675 (1961)	201134
LAKHIANI, D SHREIR, L	700978
(BATTERSEA COLL OF TECH LONDON ENGLAND)	700978
CRYSTALLIZATION OF AMORPHOUS NIOBIUM OXIDE DURING ANODIC	700978
OXIDATION	700978
NATURE 188, 49 (1960)	700978
NSA 15, 679 (1961)	700978
LAM, D DARBY, J DOWNEY, J NORTON, L	601586
(ARGONNE NATL LAB LEMONT ILL)	601586
ALPHA MANGANESE PHASES CONTAINING TECHNETIUM-99	601586

NATURE 192, 744 (1961)	601586
NSA 16, 3504 (1962)	601586
LAMBERTSON, W HANDWERK, J	601323
(ARGONNE NATL LAB LEMONT ILL)	601323
THE FABRICATION AND PHYSICAL PROPERTIES OF URANIA BODIES	601323
ANL-5053 1956,	601323
NSA 11, 2221 (1957)	601323
LAMBERTSON, W GUNZEL, F	700762
REFRACTORY OXIDE MELTING POINTS	700762
USAEC PUBL AFCD 3465 (1952)	700762
NSA 7, 564 (1953)	700762
LANDIYA, N TSAGAREISHVILI, D	301516
SIMPLIFIED EQUATIONS FOR CALCULATING THE SPECIFIC HEAT,	301516
ENTROPY, AND THE CHARACTERISTIC TEMPERATURE OF SOLID	301516
SUBSTANCES	301516
TR INST MET AKAD NAUK GRUZ SSR 12, 45, (1962)	301516
CA 58, 8462 (1963)	301516
LANDIYA, N A	301291
COMPUTATION OF HIGH-TEMPERATURE HEAT CAPACITIES OF SOLID	301291
INORGANIC SUBSTANCES BY STANDARD ENTROPY	301291
TBILISI IZD-V0 AKAD NAUK GRUZINSKOI SSR (1962)	301291
RUSS ACC VOL 16, NO 1, 151 APRIL (1963)	301291
LANE, Z TUNIS, M OLMSTED, E KENNEDY, J MAYNARD, G	201940
PHYSICAL PROPERTIES AND PHASE DIAGRAMS OF TEN REFRACTORY	201940
OXIDES II. JOURNAL LITERATURE, SELECTED BIBLIOGRAPHY	201940
US AT ENERGY COMM UCRL 6262, (1962)	201940
CA 57, 16161 (1962)	201940
LANG, S	100195
AN ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES ON THE SOLID-	100195
STATE REACTIONS OF THE URANIUM OXIDES	100195
NATL BUR STDS (US) CIRC NO 535 (1953)	100195
CA 47, 4235 (1953)	100195
LANGF, F	700563
(GEN ATOM DIV GEN DYN CORP SAN DIEGO CALIF)	700939
INVESTIGATION OF SPECIFIC HEATS AT LOW TEMPERATURES	700563
Z PHYSIK CHEM 110, 343 (1924)	700563
CA 18, 2993 (1924)	700563
LANGER, S	700939
(GEN ATOM DIV GEN DYNAMICS SAN DIEGO CAL)	700939
MELTING POINTS AND THERMODYNAMIC PROPERTIES OF SOME REACTOR	700939
CORE MATERIALS	700939
GAMD-2101	700939
NSA 15, 18490 (1961)	700939
LANGMUIR, I	700504
THE VAPOR PRESSURE OF METALLIC TUNGSTEN	700504
PHYS REV 2, 450 (1913)	700504
CA 8, 870 (1914)	700504
LANIÉSSE, J ENGLANDER, M MERIEL, P	201980
(CENTRE ETUDES NUCL SACLAY FRANCE)	201980
STUDIES ON THE EVOLUTION OF THE CRYSTALLINE STRUCTURES OF	201980
URANIUM BY NEUTRON CRYSTALLOGRAPHY	201980
PROC INTERN SYMP REACTIVITY SOLIDS 4TH AMSTERDAM 1960, 700	201980
(1960)	201980

CA 58, 1962 (1963)	201980
LAPITSKIY, A SIMANOV, Y	301112
SOME PROPERTIES OF TANTALUM PENTOXIDE 1	301112
VEST MOSKOV UNIV SER FIZ MATEMAT I YESTEST NAUK 9, NO. 3	301112
85 (1954)	301112
COTS 55, 219 (1962)	301112
LAPLACA, S BINDER, I POST, B	700803
(POLYTECH INST BROOKLYN NY)	700803
BINARY DODECABORIDES	700803
J INORG AND NUCL CHEM 18, 113 (1961)	700803
NSA 15, 26031 (1961)	700803
LAPLACA, S POST, B	300518
THE CRYSTAL STRUCTURE OF RHENIUM DIBORIDE	300518
ACTA CRYST 15, 97 (1962)	300518
BHT NO 2, 9 (1962)	300518
LARRABEE, R	201223
(MIT CAMBRIDGE MASS)	201223
THE SPECTRAL EMISSIVITY AND OPTICAL PROPERTIES OF TUNGSTEN	201223
US DEPT COMM OFFICE TECH SERV PB REPT 144927 (1957)	201223
CA 56, 1046 (1962)	201223
LASHKAREV, G SAMSONOV, G	300565
CHARACTERISTICS OF SOME REFRACTORY COMPOUNDS OF	300565
TRANSITIONAL METALS AS MATERIALS FOR THERMOELECTRIC	300565
CONVERTERS	300565
AT. ENERG. (USSR) 13, NO 2, 187 (1962)	300565
LATIMER, W	601635
RECENT REFERENCES TO THERMODYNAMIC DATA	601635
UCRL-2680 (1954)	601635
LAUBE, E NOWOTNY, H	201750
(UNIV VIENNA VIENNA AUSTRIA)	201750
THE PHASE SERIES	201750
MONTASH 93, 681 (1962)	201750
CA 57, 6717 (1962)	201750
LAVALLE, D	301517
(OAK RIDGE NATL LAB OAK RIDGE TENN)	301517
PREPARATIONS OF NITRIDE AND PHOSPHIDE OF RARE EARTH	301517
METALS	301517
J INORG NUCL CHEM 24, 930 (1962)	301517
CA 59, 3520 (1963)	301517
LAVENDEL, H	300482
(LOCKHEED MISS SP DIV PALM ALTO CALIF)	300482
ALLOYS OF TANTALUM DIBORIDE WITH IRON, COBALT, AND NICKEL	300482
PLANSEBER POLVERMET 9, 80 (1961)	300482
BHT NO 3, 8 (1961)	300482
LAVRENTYEV, V GERASIMOV, Y REZUKHINA, T	701030
THERMODYNAMIC PROPERTIES OF NIOBIUM OXIDES (EQUILIBRIUM WITH	701030
CARBON AND ELECTROCHEMICAL MEASUREMENTS)	701030
DOKLADY AKADEMIY NAUK SSSR 136, 1372 (1961)	701030
NSA 15, 15601 (1961)	701030
LAVROV, N FILIPPOVA, V KOROBOV, V CHERNENKOV, I	300341
THERMODYNAMICS OF GASIFICATION REACTIONS	300341
TRUDY INST GORYUCHIKH ISKOPAEVYKH XI, 24 (1959)	300341

COTS 46, 96 (1961)	300341
LAWLEY, A	200801
(UNIV OF PENNSYLVANIA PHILADELPHIA PENNA)	200801
CRYSTALLOGRAPHIC ANGLES FOR MAGNESIUM, RUTHENIUM,	200801
RHENIUM, ZINC, AND CADMIUM	200801
TRANS MET SOC AIME 218, 956 (1960)	200801
CA 55, 295 (1961)	200801
LAZAROVA, L KANTOR, P KANDYBA, V	700631
ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM IN THE 1200 TO 2500	700631
DEGREE K RANGE	700631
FIZ METAL I METALLOVED AKAD NAUK SSSR 11, 628 (1961)	700631
CT NO 12, (1961)	700631
LAZARUS, D	301518
(UNIVERSITY OF ILLINOIS URBANA ILLINOIS)	301518
DIFFUSION STUDIES OF VACANCIES AND IMPURITIES	301518
J PHYS RADIUM 23, 772 (1962)	301518
CA 58, 7685 (1963)	301518
LEBEDEV, K	300828
THE CHEMISTRY OF RHENIUM	300828
METALLURGIZDAT (1960)	300828
COTS 56, 149 (1962)	300828
LEBEDEV, V	700702
ATOMIC HEAT CAPACITY OF ELEMENTS	700702
DOKLADY AKAD NAUK SSSR 63, 645 (1948)	700702
CA 43, 3671 (1949)	700702
LEBEDEV, V	200842
DETERMINATION OF HEAT CONDUCTIVITY OF METALS	200842
AT HIGH TEMPERATURES	200842
FIZ METAL I METALLOVED, AKAD NAUK SSSR 10, 187 (1960)	200842
CA 55, 4078 (1961)	200842
LEBEDEV, V	201312
(PHYS TECH INST KHARKOV RUSSIA)	201312
THERMAL-CONDUCTIVITY MEASUREMENTS OF METALS AT HIGH	201312
TEMPERATURE	201312
UKRAIN FIZ ZHUR 6, 522 (1961)	201312
CA 56, 5417 (1962)	201312
LEBLANC, F TANAKA, Y JURSA, A	600589
(AIR FORCE CAMBRIDGE RES CTR BEDFORD MASS)	600589
NEW BAND SYSTEM IN THE AFTERGLOW OF NITROGEN	600589
J CHEM PHYS 28, 979 (1958)	600589
CA 52, 15265 (1958)	600589
LECERF, A	300939
CHEMICAL PROPERTIES OF TITANIUM MONOXIDE AND TITANIUM	300939
SESQUIOXIDE, PREPARATION AND STUDY OF NEW TERNARY COMPOUNDS	300939
OF TRIVALENT TITANIUM CONTAINING OXYGEN	300939
ANN CHIM (PARIS) 7, 513 (1962)	300939
LECIEJEWICZ, J	201199
(INST NUCLEAR RESEARCH WARSAW POLAND)	201199
A NOTE ON THE STRUCTURE OF TUNGSTEN CARBIDE	201199
ACTA CRYST 14, 200 (1961)	201199
CA 56, 86 (1962)	201199

LECIEJEWICZ, J (POLISH ACADEMY OF SCI INST OF NUCLEAR RESEARCH A NOTE ON THE STRUCTURE OF TUNGSTEN CARBIDE NP-9682 (1960) NS 15, 6387 (1961)	WARSAW)	600865 600865 600865 600865 600865
LEFEVRE, J (ETUDES CHIM MET SOME STRUCTURAL MODIFICATIONS OF FLUORITE-TYPE PHASES IN SYSTEMS BASED ON ZIRCONIA OR HAFNIUM OXIDE ANN CHIM (PARIS) 8 NOS 1-2, 117 (1963) CA 48, 3378 (1963)	VITRY FRANCE)	301519 301519 301519 301519 301519 301519
LEFEVRE, J COLLONGUES, R JORBA, M THE EXISTENCE OF A CONTINUOUS TRANSITION FROM THE TETRAGONAL STRUCTURE TO THE CUBIC STRUCTURE IN THE SYSTEM ZIRCONIA-RARE EARTH OXIDES COMPT REND 249, 2329 (1959) CA 55, 14001 (1961)		201021 201021 201021 201021 201021 201021
LEGVOLD, S SPEDDING, F BARSON, F ELLIOT, J (IOWA STATE COLL MAGNETIC AND ELECTRIC PROPERTIES OF GADOLINIUM, DYSPROSIUM AND ERBIUM METALS REVS MOD PHYS 25, 129 (1953) CA 47, 9078 (1953)	AMES IOWA)	100189 100189 100189 100189 100189 100189
LEHMAN, G (ATOMICS INT DIV N A AV INC CANOGA PARK THERMAL PROPS OF REFRACTORY MATERIALS WADD-TR-60-581 (1960) AD 247411 DIV 25 (1960) NSA 15, 14743 (1961)	CALIF)	300304 300304 300304 300304 300304 300304
LEHR, P LANGERON, J DILATOMETRIC STUDY OF ALPHA-PHASE URANIUM REV MET 54, 257 (1957) CA 51, 11800 (1957)		601058 601058 601058 601058
LEHR, P LANGERON, J EXPANSION BEHAVIOR OF SINGLE CRYSTALS OF URANIUM COMPT REND 241, 1130 (1955) CA 50, 5353 (1956)		601005 601005 601005 601005
LEHRLE, R ROBB, J THOMAS, D MODIFIED TIME OF FLIGHT MASS SPECTROMETER FOR STUDYING ION-MOLECULE OR NEUTRAL PARTICLE-MOLECULE INTERACTION J SCI INST. 39 (1962)		301520 301520 301520 301520
LEIBOWITZ, L SCHNIZLEIN, J BINGLE, J VOGEL, R (ARGONNE NATL LABS THE KINETICS OF OXIDATION OF URANIUM BETWEEN 125 AND 250 DEGREES CA 56, 5434 (1962) J. ELECTROCHEM SOC. 108, 1155 (1961)	ARGONNE ILL)	201314 201314 201314 201314 201314 201314
LEITNAKER, J BOWMAN, M GILLES, P (LASL HIGH TEMPERATURE PHASE STUDIES IN THE TANTALUM-BORON SYSTEM BETWEEN TA AND TB J ELECTROCHEM SOC 108, 568 (1961) NSA 15, 14906 (1961)	LOS ALAMOS NEW MEX)	700595 700595 700595 700595 700595 700595

LEITNAKER, J BOWMAN, M GILLES, P	300392
HIGH TEMPERATURE EVAPORATION AND THERMODYNAMIC PROPERTIES OF	300392
ZIRCONIUM DIBORIDE	300392
JCP 36, 350 (1962)	300392
CA 57, 4060 (1962)	300392
LEITNAKER, J BOWMAN, M GILLES, P	300553
THERMODYNAMIC PROPERTIES OF THE TANTALUM AND TUNGSTEN	300553
BORIDES	300553
J ELECTROCHEM SOC 109, NO 5, 441 (1962)	300553
BHT NO 2, 50 (1962)	300553
CA 57, 4111 (1962)	300553
LEITNAKER, J KRIKORIAN, N KRUPKA, M	300408
UNUSUAL TERNARY BEHAVIOR OF TRANSITION METAL BORIDES	300408
J ELECTROCHEM SOC 109, NO 1 66 (1962)	300408
LEITNAKER, J WITTEMAN, W	300393
DISSOCIATION PRESSURE OF URANIUM DICARBIDE	300393
JCP 36, 1445 (1962)	300393
LEMMON, A WARD, J FISCHER, S GFANKOPLIS, C CLEGG, J	601012
(BATTELLE MEM INST COLUMBUS OHIO)	601012
THE THERMODYNAMICS OF THE REDUCTION OF URANIUM COMPOUNDS	601012
TO URANIUM METAL	601012
U S ATOMIC ENERGY COMM B M I 550, 42 (1952)	601012
CA 50, 8311 (1956)	601012
LENZI, D PELLEGRINI, P	200865
SINTERED BORON CARBIDE	200865
GAZZ CHIM ITAL 89, 1725 (1959)	200865
CA 55, 5210 (1961)	200865
LEONOV, A RUDENKO, V KALER, E	301521
RELATIONS BETWEEN CE2O3 AND SiO2 AT HIGH TEMPERATURE	301521
IZV AN SSSR OTD KHIM NAUK NO 11, 1925 (1961)	301521
RUSS ACC 14 FEB 1962	301521
LEONOV, A	301522
CATALYTIC ACTION OF WATER ON THE CHEMICAL REACTION BETWEEN	301522
OXIDES AT HIGH TEMPERATURES	301522
IZV. AKAD. NAUK SSSR, OTD. KHIM NAUK 1961, 1411-16	301522
CA 58, 962 (1963)	301522
LEPINSKIKH, B ESIN, O TETERIN, G	201215
SURFACE TENSION AND DENSITY OF MELTS CONTAINING	201215
OXIDES OF LEAD, VANADIUM AND SILICON	201215
ZHUR NEORG KHIM 5, 642 (1960)	201215
CA 56, 996 (1962)	201215
LEVESQUE, P BEKEBREDE, W BROWN, H	201149
(RAYTHEON MANUF CO WALTHAM MASS)	201149
THE CONSTITUTION OF RHENIUM-NIOBIUM ALLOYS	201149
TRANS AM SOC METALS 53, 215 (1961)	201149
CA 55, 20874 (1961)	201149
LEVINSON, L S	301292
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	301292
HEAT CONTENT OF URANIUM DICARBIDE FROM 1484 DEGREES TO 2581	301292
DEGREES K	301292
J CHEM PHYS 38, (9) 2105 (1963)	301292

BHT NO 2, 30 (1963)	301292
LEVINSON, L	300935
HIGH TEMPERATURE DROP CALORIMETER	300935
REV SCI INST 33, 639 (1962)	300935
LEVINSØN, M KØVRØV, B	301100
MECHANISM OF OXIDATION BY ULTRASOUND	301100
IZ SIBIRSKØGØ OT AKAD NAUK SSSR NO 12 67 (1960)	301100
CØTS 54, 254 (1962)	301100
LEWIS, C	300234
(CHRYSLER CORP OF DETROIT DETROIT MICHIGAN)	300234
RESEARCH PROGRAM ON SEMICONDUCTING COMPOUNDS FOR THERMO-	300234
ELECTRIC POWER GENERATION AT HIGH TEMPERATURE	300234
BIMONTHLY PROG REPT NO 5 (1961) CONTRACT 78664	300234
AD 259104	300234
LEWIS, J	201262
FURTHER EVALUATION OF BERYLLIDES	201262
(NORTH AMERICAN AVIATION CO CANOGA PARK CALIF)	201262
J METALS 13, 829 (1961)	201262
CA 56, 2255 (1962)	201262
LIBBY, W F	202086
(UNIV OF CALIFORNIA LOS ANGELES CALIF)	202086
HIGH PRESSURE CHEMISTRY	202086
NATL ACAD SCI US 48, 1475 (1962)	202086
CA 58, 5047H (1963)	202086
LICHTER, B	200774
(AIR FORCE CAMBRIDGE RES BEDFORD MASS)	200774
PRECISION LATTICE-PARAMETER DETERMINATION OF ZIRCONIUM-	200774
OXYGEN SOLID SOLUTIONS	200774
TRANS MET SOC AIME 218, 1015 (1960)	200774
NSA 15, 5408 (1961)	200774
CA 55, 6981 (1961)	200774
LIDMAN, W HAMJIAN, H	300158
REACTIONS DURING SINTERING OF A ZIRCONIUM CARBIDE-NIØBIUM	300158
CERMET	300158
J AM CERAM SOC 35, NO 9 (1952)	300158
LIEN, W	201454
(US AT ENERGY COMM)	201454
HEAT CAPACITY STUDIES AT LIQUID-HE TEMPERATURES AND BELOW. I.	201454
ALKALI METALS. II. SMALL PARTICLES OF MGØ	201454
UCRL-9880, (1962)	201454
CA 56, 11000 (1962)	201454
LIHL, F ETTMAYER, P KUTZELNIGG, A	301025
(TECH HOCHSCHULE VIENNA)	301025
THE SYSTEM MANGANESE-NITRØGEN	301025
Z METALLK 53, 715 (1962)	301025
CA 58, 5338 (1963)	301025
LIKHTER, A	601492
THE PHASE DIAGRAM OF CERIUM	601492
ZHUR EKSPTL I TEØRET FIZ 33, 610 (1957)	601492
AEC-TR-3249	601492
NSA 12, 10192 (1958)	601492
LIKHTER, A RYABININ, Y VERESHCHAGIN, L	601072

CERIUM PHASE DIAGRAM SOVIET PHYS JETP. 6, 469 (1958) CA 52, 14307 (1958)	601072 601072 601072
LIKHTER, A RYABININ, Y VERESHCHAGEN, L THE CERIUM PHASE DIAGRAM	601108 601108
LINCØLN, R ASAI, G KATØ, H SØME PRØPERTIES ØF VANADIUM BUR MINES REPØRT 5975 (1962) GØVT PUB 12397	301525 301525 301525 301525
LINBIMØV, V GELD, P EQUILIBRIUM IN THE REDUCTION ØF NIØBIUM PENTØXIDE BY HYDRØGEN IZV VYS UCHEB ZAV TSVET MET 4, NØ 5 1JK (1961) RUSS ACC 14, 2749 (1962)	300388 300388 300388 300388
LINDHØLM, F IONIZATION AND FRAGMENTATION ØF N2 BY BØMBARDMENT WITH ATØMIC IØNS. DISSØCIATION ENERGY ØF N2 ARK FYS 8, 257 (1954) PA 58, 2826 (1955)	600590 600590 600590 600590 600590
LINDHØLM, F IONIZATION AND FRAGMENTATION ØF CØ BY BØMBARDMENT WITH ATØMIC IØNS. DISSØCIATION ENERGY ØF CØ. HEAT ØF SUBLIMATION ØF CARBØN ARK FYS 8, 433 (1954) PA 58, 1010 (1955)	600714 600714 600714 600714 600714
LIPMAN, R APPARATUS FØR THE MEASUREMENT AND RECORDING ØF THE VISCØSITY ØF SILICATE MELTS STEKLØ I KERAMIKA 16, 2, 18 (1959)	400596 400596 400596 400596
LIPPINCØTT, E SCHRØEDER, R STEELE, D (UNIV ØF MARYLAND COLLEGE PARK MARYLAND) DISSØCIATION ENERGIES ØF DIATØMIC MØLECULES J CHEM PHYS 34, 1448 (1961)	300402 300402 300402 300402
LIPPINCØTT, E STEELE, D CALDWELL, P (UNIV ØF MARYLAND COLLEGE PARK MARYLAND) GENERAL RELATION BETWEEN POTENTIAL ENERGY AND INTERNUCLEAR DISTANCE FØR DIATØMIC MØLECULES. III. EXCITED STATES J CHEM PHYS 35, 123 (1961)	700683 700683 700683 700683 700683
LITTLE, A D COMPANY INC (AD LITTLE CØ CAMBRIDGE MASS) THERMODYNAMIC AND KINETIC STUDIES FØR A REFRACTØRY MATERIALS PRØGRAM AD 277500 APR (1962)	301526 301526 301526 301526 301526
LIU, S (IØWA STATE UNIV AMES IØWA) MAGNETIC PRØPERTIES ØF RARE EARTH METALS UNIV MICROFILMS (ANN ARBOR MICH) LC CARD MIC 60-5687 DISSERTATION ABSTR 21, 2341 (1961) CA 55, 11981 (1961)	200972 200972 200972 200972 200972 200972
LIUTAIA, M D BUKHANEVICH, V F CHEMICAL AND THERMAL STABILITY ØF NITRIDES ØF ELEMENTS ØF THE THIRD GROUP ZHUR NEØRG KHIM 7 NØ 11- 2487 (1962) RUSS ACC VØL 15, NØ 12, 3268 (MARCH 1963)	202088 202088 202088 202088 202088

LIVANOV, V BUKHANOVA, A KOLACHEV, B	300386
EFFECT OF OXYGEN AND HYDROGEN ON THE STRUCTURE AND PROPERTIES	300386
OF TITANIUM	300386
TRUDY MATI NO 50 82 (1961)	300386
LIVSHITS, L GENSHAFT, Y MARKOV, V	301524
(INST CHEM PHYS ACAD SCI MOSCOW RUSSIA)	301524
PHASE DIAGRAM OF CERIUM IN THE RANGE OF TEMPERATURES FROM	301524
20 TO 350 DEGREES UNDER A PRESSURE UP TO 80000	301524
KG/SQ CM	301524
ZH EKSPERIUM I TEOR FIZ 43, 1262 (1962)	301524
CA 58, 7419 (1963)	301524
LLÖYD, L	601203
THERMAL EXPANSION OF ALPHA-URANIUM SINGLE CRYSTALS	601203
US ATOMIC ENERGY COMM ANL-5972, 48 (1959)	601203
J NUCLEAR MATERIALS (INTERNAT) 3, NO 1, 67 (1961)	601203
CA 54, 4132 (1960)	601203
PA 65, 2057 (1962)	601203
LÖCH, L GAMBINO, J DUCKWORTH, W	601015
(BATTELLE MEMORIAL INSTITUTE COLUMBUS OHIO)	601015
DIFFUSION OF URANIUM THROUGH GRAPHITE	601015
A I CHE JOURNAL 2, 195 (1956)	601015
CA 50, 12584 (1956)	601015
LÖNGUET-HIGGINS, H ROBERTS, M	600935
(KINGS COLLEGE LONDON ENGLAND)	600935
THE ELECTRONIC STRUCTURE OF THE BORIDES MB6	600935
PROC ROY SOC A224, 336 (1954)	600935
CA 49, 50 (1955)	600935
LÖSEV, S GENERALOV, N	301113
A STUDY OF THE EXCITATION OF VIBRATIONS AND DISSOCIATION OF	301113
OXYGEN MOLECULES AT HIGH TEMPERATURES	301113
DOK AKAD NAUK SSSR 141, 1072 (1961)	301113
COTS 54, 295 (1962)	301113
LÖFTHUS, A	600568
A NEW PREDISSOCIATION IN NITROGEN	600568
NATURE 186, 302 (1960)	600568
LÖFTHUS, A	600591
EMISSION BAND SPECTRA OF NITROGEN. THE FIFTH POSITIVE SYSTEM	600591
J CHEM PHYS 25, 494 (1956)	600591
CA 51, 849 (1957)	600591
LÖFTHUS, A	600592
(UNIV OSLO OSLO NORWAY)	600592
EMISSION BAND SPECTRA OF NITROGEN, A STUDY OF SOME SINGLET	600592
SYSTEMS	600592
CAN J PHYSICS 35, 216 (1957)	600592
CA 51, 5548 (1957)	600592
LÖFTHUS, A MULLIKEN, R	600593
EMISSION BAND SPECTRA OF NITROGEN. KAPLANS FIRST AND SECOND	600593
SYSTEMS	600593
J CHEM PHYS 26, 1010 (1957)	600593
CA 51, 13568 (1957)	600593
LÖH, E NEWMAN, R	700526
INFRARED PROPERTIES OF FLAME-FUSED MnO CRYSTALS	700526

J APP PHYS 32, 470 (1961)	700526
LØRIERS, J	400542
THE ØXIDATION ØF CERIUM AND LANTHANUM	400542
CØMPT REND 229, 547 (1949)	400542
CA 44, 473 (1950)	400542
LØUNASMAA, Ø	301527
(ARGØNNE NATL LAB ARGØNNE ILL)	301527
SPECIFIC HEAT ØF GADØLINIUM AND YTTERBIUM METALS	301527
BETWEEN 0.4 AND 4 DEGREES K	301527
PHYS. REV. 129, 2460 (1963)	301527
CA 58, 8463 (1963)	301527
LØUNASMAA, Ø RØACH, P	701082
(ARGØNNE NATL LAB LEMØNT ILL)	701082
SPECIFIC HEAT ØF TERBIUM METAL BETWEEN 0.37 AND 4.2	701082
DEGREES K	701082
PHYS REV 128, 622 (1962)	701082
TID-16630	701082
NSA 17, 570 (1963)	701082
LØUNASMAA, Ø	701077
(ARGØNNE NATL LAB LEMØNT ILL)	701077
SPECIFIC HEAT ØF HØLMIIUM METAL BETWEEN 0.38 AND 4.2	701077
DEGREES K	701077
PHYS REV 128, 1136 (1962)	701077
NSA 17, 577 (1963)	701077
LØUNASMAA, Ø	300780
SPECIFIC HEAT ØF SAMARIUM METAL BETWEEN 0.4 AND 4 DEGREES K	300780
PHYS REV 126, 1352 (1962)	300780
PA 65, 12387 (1962)	300780
LØUNASMAA, Ø GUENTHER, R	300779
SPECIFIC HEAT ØF DYSPRØSIUM METAL BETWEEN 0.4 AND 4 DEGREES K	300779
PHYS REV 126, 1357 (1962)	300779
PA 65, 12388 (1962)	300779
LØVE, B	201960
(NUCLEAR CØRP ØF AMERICA PHØENIX ARIZ)	201960
THE PREPARATION ØF HIGH-PURITY RARE EARTH METALS	201960
U S DEPT CØM ØFFICE TECH SERV A D 267,102 (1961)	201960
CA 58, 304 (1963)	201960
LØVE, B	201699
(RES CHEMS INC BURBANK CALIF)	201699
THE METALLURGY ØF YTTRIUM AND THE RARE EARTH METALS I PHASE	201699
RELATIONS,	201699
U S DEPT CØM ØFFICE TECH SERV, PB REPT 171, 085, (1960)	201699
CA 57, 4433 (1962)	201699
LØVE, B	700735
(RES CHEM DIV NUCLEAR CØRP ØAK RIDGE TENN)	700735
TECHNØLØGY ØF SCANDIUM, YTTRIUM, AND THE RARE EARTH METALS	700735
WADD-TR-60-864 (1960)	700735
NUC SCI ABST 16, 12116 (1962)	700735
LØVE, B KLEBER, E	201733
(NUCLEAR CØRP ØF AMERICA BURBANK CALIF)	201733
PURIFICATION ØF RARE EARTH METALS	201733
ULTRAPURIF SEMICØND MATFR, PRØC CØNF, BØSTØN, MASS	201733
1961, 145 (1962)	201733

CA 57, 5757 (1962)	201733
LOVEJOY, D R	202087
SOME BOILING AND TRIPLE POINTS BELOW 0 DEGREES C	202087
NATURE 197, 353 (1963)	202087
CA 59, 43 (1963)	202087
LWELL, C WILLIAMS, W	300410
HIGH TEMPERATURE CALORIMETER FOR THE DETERMINATION OF HEATS	300410
OF FORMATION OF REFRACTORY COMPOUNDS	300410
REV SCI INST 32, 1120 (1961)	300410
LWENSTEIN, V	600919
INTERFEROMETRIC SPECTRA OF AMMONIA AND CARBON MONOXIDE IN	600919
THE FAR INFRARED	600919
J OPT SOC AM 50, NO 12, 1163 (1960)	600919
PA 64, 841 (1961)	600919
LWENTHAL, G	300938
SPECIFIC HEAT OF METALS BETWEEN 1200 DEGREES K AND	300938
2400 DEGREES K	300938
AUSTRALIAN J PHYS 16, 47 (1963)	300938
LWRIE, R	701081
(UNION CARBIDE RES INST TARRYTOWN NY)	701081
RESEARCH ON CHEMICAL AND PHYSICAL PRINCIPLES AFFECTING HIGH	701081
TEMPERATURE MATERIALS FOR ROCKET NOZZLES	701081
NP-12130	701081
NSA 17, 416 (1963)	701081
LWRIE, R	700943
(UNION CARBIDE NUCLEAR CO TUXEDO NY)	700943
RESEARCH IN PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH	700943
TEMPERATURE MATERIALS FOR ROCKET NOZZLES	700943
AD-239305	700943
NSA 15, 21067 (1961)	700943
LWRIE, R	700956
(UNION CARBIDE CORP TARRYTOWN NY)	700956
RESEARCH IN PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH	700956
TEMPERATURE MATERIALS FOR ROCKET NOZZLES	700956
NP-10401	700956
NSA 15, 25130 (1961)	700956
LWRIF, R	601596
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES	601596
AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES	601596
NP 11311	601596
NSA 16, 16726 (1962)	601596
LWRIE, R	701014
(UNION CAR NUC CO RES CENTER TUXEDO NY)	701014
RESEARCH IN PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH	701014
TEMPERATURE MATERIALS FOR ROCKET NOZZLES	701014
NP-9843 (1960)	701014
NSA 15, 11592 (1961)	701014
LWRIF, R GRIST, R SCHOMAKER, V	300412
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH	300412
TEMPERATURE MATERIALS FOR ROCKET NOZZLES	300412
UNION CARBIDE CORP SEMI ANNUAL PROG REPT DEC 31 1961	300412
CONTRACT DA-30-069-ORD-2787	300412

LOWRIE, R SCHOMCHER, V KEBLER, R CRIST, R	300940
(LAB OF UNION CARBIDE CORP TARRYTOWN NY)	300940
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH	300940
TEMPERATURE MATERIALS FOR ROCKET NOZZLES	300940
QUARTERLY PROGRESS REPORT DEC 31, 1962	300940
LU, S CHANG, Y	700512
THE ACCURATE EVALUATION OF LATTICE SPACINGS FROM BACK	700512
REFLECTION POWDER PHOTOGRAPHS	700512
PROC PHYS SOC (LONDON) 53, 517 (1941)	700512
CA 36, 358 (1942)	700512
LUCKS, C DEEM, H WOOD, W	601691
(BATTELLE MEMORIAL INST COLUMBUS OHIO)	601691
THERMAL PROPERTIES OF SIX GLASSES AND TWO GRAPHITES	601691
AM CERAM SOC BULL 39, 313 (1960)	601691
NS 14, 17012 (1960)	601691
LUKESH, J	601652
NOTE ON THE STRUCTURE OF URANIUM	601652
ACTA CRYST 2, 420 (1949)	601652
LUNDIN, C	201119
(UNIV OF DENVER DENVER COLOR)	201119
THE DETERMINATION OF THE EQUILIBRIUM PHASE DIAGRAM, ZIRCONIUM-	201119
NIOBIUM	201119
US AT ENERGY COMM AECU-4402 (1959)	201119
CA 55, 18523 (1961)	201119
LUNDIN, C	201120
(UNIV OF DENVER DENVER COLORADO)	201120
THE DETERMINATION OF THE EQUILIBRIUM PHASE DIAGRAM	201120
ZIRCONIUM-NIOBIUM	201120
US AT ENERGY COMM AECU-44448 (1959)	201120
CA 55, 18524 (1961)	201120
LUNDIN, C E	202089
(UNIV DENVER DENVER COLOR)	202089
A STRUCTURAL SURVEY OF THE HEAVY RARE EARTH SILICIDES	202089
RARE EARTH RES SEMINAR LAKE ARROWHEAD CALIF 1960, 306 (1961)	202089
CA 58, 9927C (1963)	202089
LUNDIN, C COX, R	300240
THE DETERMINATION OF THE EQUILIBRIUM PHASE DIAGRAM ZIRCONIUM-	300240
NIOBIUM	300240
USAFEC TID-11919, 52 (1960)	300240
CA 55, 21772 (1961)	300240
LUNDIN, C KLÖDT, D	201630
(UNIV DENVER DENVER COLOR)	201630
THE ALLOY SYSTEMS OF THE GROUP VA METALS WITH YTTRIUM	201630
J INST METALS 90, 341 (1962)	201630
CA 57, 3159 (1962)	201630
LUNDIN, C KLÖDT, D	601346
FUNDAMENTAL ALLOY DEVELOPMENT STUDIES	601346
QUARTERLY PROG REPT NO 8, FOR AUG 1, 1957-OCT 31, 1957	601346
APEX-349 (DEL)	601346
NSA 14, 12919 (1960)	601346
LUNDIN, C KLÖDT, D	201582
(UNIV OF DENVER COLOR)	201582
PHASE EQUILIBRIA OF THE GROUP IVA METALS WITH YTTRIUM	201582

TRANS AIME 224, 376 (1962)	201582
CA 57, 523 (1962)	201582
LUNGU, S	300736
THERMODYNAMIC PROPERTIES OF ZIRCONIUM AND	300736
HAFNIUM HALIDES	300736
ACAD REP POPULARE ROMINE STUDII CERECETARI	300736
FIZ 13, 29 (1962)	300736
LUNSFORD, J FRIES, R KEMPTER, C	601466
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	601466
CRYSTALLOGRAPHIC DATA, URANIUM DIBORIDE	601466
CRYSTAL FRONT 2, 13, (1961)	601466
NSA 16, 18052 (1962)	601466
LUX, H EBERLE, L	700628
SALTS AND OXIDES OF BIVALENT CHROMIUM	700628
CHEM BER 94, 1562 (1961)	700628
CT NO 13, (1961)	700628
LVØV, S	300937
THERMAL CONDUCTIVITY OF HIGH-MELTING BORIDES, CARBIDES,	300937
AND NITRIDES	300937
POROSHKOV METALLURGIYA NO 6, 70 (1961)	300937
COTS NO 60, 82 (1962)	300937
LVØV, S N NEMCHENKO, V F PADERNO, U B	202090
HEAT CONDUCTIVITY OF THE HEXABORIDES OF ALKALI METALS	202090
AND RARE EARTH METALS	202090
DOKL AKAD NAUK SSSR 146, 1371 (1963)	202090
CHEM TITLES NO 12, 79 JUNE 10 1963	202090
LVØV, S NEMCHENKO, V KISLYI, P VERKHOGLYADOVA, T	201981
KOSOLAPOVA, T	201981
(IN K KRUPSKII ST PEDAGOG KHERSON USSR)	201981
ELECTRICAL PROPERTIES OF BORIDES, CARBIDES, AND NITRIDES OF	201981
CHROMIUM	201981
POROSHKOVAYA MET AKAD NAUK UKR SSR 2, NO 4, 20 (1962)	201981
CA 58, 1975 (1963)	201981
LVØV, S NEMCHENKO, V KOSOLAPOVA, T SAMSONOV, G	200968
ELECTRICAL PROPERTIES OF CHROMIUM CARBIDES	200968
FIZ METAL I METALLOVED AKAD NAUK SSSR 11, NO 1, 143 (1961)	200968
CA 55, 11231 (1961)	200968
LVØV, S NEMCHENKO, V SAMSONOV, G	201673
(INST OF METAL CER, AKAD SCI UKR SSR, KIEV RUSSIA)	201673
ELECTRIC PROPERTIES OF TITANIUM CARBIDE-TITANIUM NITRIDE	201673
ALLOYS UKR FIZ ZH 7, 331 (1962)	201673
CA 57, 4139 (1962)	201673
LYNCH, C VAHLDEK, F ROBINSON, L	700520
MONOCLINIC-TETRAGONAL TRANSITION OF ZIRCONIA	700520
J AM CERAM SOC 44, 147 (1961)	700520
LYNDS, L	201682
(AT INTERN CANOGA PARK CALIF)	201682
PREPARATION OF STOICHIOMETRIC UO2 BY THERMAL DECOMPOSITION OF	201682
UO2I2	201682
U S AT ENERGY COMM NAA-SR 6643, (1962)	201682
CA 57, 4268 (1962)	201682
LYUBIMOV, V D GELD, P	301294

EQUILIBRIUM FOR HYDROGEN REDUCTION OF NIOBIUM PENTOXIDE IZVEST VUZ TSVET MET 4, NO 5, 145 (1961) CA 56, 9783B (1962)	301294 301294 301294
LYURITOV, Y N DETERMINATION OF VAPOR PRESSURE OF METALS AND ALLOYS BY MEANS OF THE MASS SPECTROMETER DOKL AKAD NAUK SSSR 125, 135 (1959) BHTG NO 8, 1 (1963)	301295 301295 301295 301295 301295
LYUTAYA, M D BUKHANEVICH, V F (INST CERMETS MOSCOW RUSSIA) CHEMICAL AND THERMAL STABILITY OF NITRIDES OF GROUP III ELEMENTS ZH NEORGAN KHIM 7, 2487 (1962) CA 58, 4143B (1963)	301528 301528 301528 301528 301528 301528
LYUTAYA, M D SAMSONOV, G V PREPARATION AND PROPERTIES OF LANTHANUM NITRIDE UKR KHIM ZH 29 (3), 251 (1963) CA 59, 3519D (1963)	301529 301529 301529 301529
LYUTAYA, M NAZARCHUK, T MODILEVSKAYA, K SIMILAR EFFECTS OF BORON CARBIDE AND A METALLIC BORIDE ON THE SINTERING OF CAO AND BAC ₂ O ₃ ZH NEORG KHIM 6, NO 12, 2738 (1961) BHT NO 2, 19 (1962)	300526 300526 300526 300526 300526
MACKENZIE, J FUSION OF QUARTZ AND CRISTOBALITE J AM CERAM SOC 43, 615 (1960) BHT, (1960)	300139 300139 300139 300139
MACKENZIE, J (GE RESEARCH LAB SCHENECTADY NY) THE STRUCTURE OF BORON OXIDE AND SIMPLE BORATES ARL-TN-60-130 (1960) NA 15, 12893 (1961)	600882 600882 600882 600882 600882
MACKENZIE, J CLAUSSEN, W CRYSTALLIZATION AND PHASE RELATIONS OF BORON TRIOXIDE AT HIGH PRESSURES J AM CERAMIC SOC 44, 79 (1961)	700516 700516 700516 700516
MACWOOD, G (UNIV OF CALIF LIVERMORE CALIF) THERMODYNAMIC PROPERTIES OF URANIUM COMPOUNDS US ATOMIC ENERGY COMM TID-5290 2, 543 (1958) CA 53, 17655 (1959)	601143 601143 601143 601143 601143
MAGEE, E (ESSO RESEARCH + ENG CO LINDEN N J) J INORG NUCL CHEM 22, 155 (1961) PRODUCT OF REACTION OF BF ₃ WITH B ₂ O ₃ CA 56, 13627 (1962)	201511 201511 201511 201511 201511
MAGNELI, A (STOCKHOLM UNIV) STUDIES ON THE CRYSTAL CHEMISTRY OF TITANIUM VANADIUM AND MOLYBDENUM OXIDES AND OF ALKALI WOLFRAM BRONZES AT ELEVATED TEMPERATURES NP 8879, (1960)	600617 600617 600617 600617 600617 600617

NS 14, 20616 (1960)	600617
MAGNELI, A ANDERSSON, S ASBRINK, S WESTMAN, S HÖLMBERG, B (UNIV STOCKHOLM STOCKHOLM SWEDEN)	201566 201566
CRYSTAL CHEMISTRY OF TITANIUM, VANADIUM, AND ZIRCONIUM OXIDES AT ELEVATED TEMPERATURES	201566 201566
U S DEPT COMM, OFFICE TECH SERV, P B REPT 145, 923 (1961)	201566
CA 57, 164 (1962)	201566
MAGNUS, A DANZ, H	700560
THE SPECIFIC HEAT OF TUNGSTEN, BORON, BORON NITRIDE AND BERYLLIUM OXIDE	700560 700560
ANN PHYS 81, 407 (1926)	700560
CA 21, 3534 (1927)	700560
MAGNUS, A HÖLZMANN, H	700562
INVESTIGATION ON THE SPECIFIC HEATS OF TANTALUM, TUNGSTEN AND BERYLLIUM BETWEEN 100 AND 900 DEGREES C	700562 700562
ANN PHYS 3, 585 (1929)	700562
CA 24, 1018 (1930)	700562
MAH, A	600689
HEATS OF FORMATION OF CERIUM SESQUIOXIDE AND BISMUTH SESQUIOXIDE BY COMBUSTION CALORIMETRY	600689 600689
US BUR MINES REPT INVEST NO 5676 (1961)	600689
CA 55, 10039 (1961)	600689
MAH, A	700705
HEATS AND FREE ENERGIES OF FORMATION OF GALLIUM SESQUIOXIDE AND SCANDIUM SESQUIOXIDE	700705 700705
US BUR MINES REPT INVEST 5965 (1962)	700705
MAH, A D	202093
(US BUR OF MINES BERKELEY CALIF)	202093
HEAT AND FREE ENERGIES OF FORMATION OF BARIUM OXIDE AND STRONTIUM OXIDE	202093 202093
US BUR MINES REPT INVEST NO 6171, 8 (1963)	202093
CA 58, 9679D (1963)	202093
MAH, A D BOYLE, B J	301297
HEATS OF FORMATION OF NIOBIUM CARBIDE AND ZIRCONIUM CARBIDE FROM COMBUSTION CALORIMETRY	301297 301297
J A C S 77, 6512 (1955)	301297
MAH, A KELLEY, K	300406
HEATS AND FREE ENERGIES OF FORMATION OF OXIDES OF VANADIUM B OF MINES REPORT 5858 (1961)	300406 300406
CA 56, 4163 (1962)	300406
MAH, A ET AL	300413
THERMODYNAMIC PROPERTIES OF ALUMINUM NITRIDE	300413
BUR MINES REPORT 5716 (1961) 8 PAGES ITEM 637A	300413
US GOVT PUB 7927, 70 (1961)	300413
MAJUMDAR, K VARSHNI, Y	600886
SPECTROSCOPIC CONSTANTS OF MOLECULES. I. GROUND STATE FREQUENCIES OF DIATOMS OF TYPE XX	600886 600886
INDIAN J PHYS 28, 103 (1954)	600886
CA 51, 7832 (1957)	600886
MAJUMDAR, K VARSHNI, Y	600887
SPECTROSCOPIC CONSTANTS OF MOLECULES. II. THE VIBRATION FREQUENCIES OF DIATOMS OF THE TYPE XY	600887 600887

INDIAN J PHYS 28, 209 (1954)	600887
CA 51, 7832 (1957)	600887
MAJUMDAR, K VARSHNI, Y	600888
SPECTROSCOPIC CONSTANTS OF MOLECULES. III. REGULARITIES IN	600888
VIBRATION FREQUENCIES IN A MOLECULAR GROUP	600888
INDIAN J PHYS 28, 38 (1955)	600888
CA 51, 7832 (1957)	600888
MAJUMDAR, K VARSHNI, Y	600889
SPECTROSCOPIC CONSTANTS OF MOLECULES. IV. SIMILARITIES	600889
IN GROUND STATE VIBRATION FREQUENCIES OF ISOELECTRONIC	600889
DIATOMS	600889
INDIAN J PHYS 28, 285 (1954)	600889
CA 51, 7832 (1957)	600889
MAKAROV, E	601370
CRYSTAL CHEMISTRY OF SIMPLE COMPOUNDS OF URANIUM,	601370
THORIUM, PLUTONIUM, AND NEPTUNIUM	601370
NEW YORK CONSULTANTS BUREAU INC (1959)	601370
NSA 14, 1486 (1960) (TRANSLATION)	601370
ORIGINAL REF-NSA 13, 4551 (1959)	601370
MAKAROV, E	301114
THE HOMOLOGOUS SERIES OF URANIUM OXIDES UO_{2N+2}	301114
DOK AKAD NAUK SSSR 139, 612 (1961)	301114
COTS 54, 288 (1962)	301114
MAKAROV, E KUZNETSOV, I	600772
CRYSTAL STRUCTURE AND CHEMICAL NATURE OF THE LOWER OXIDES	600772
OF TITANIUM $TiO_{0-0.48}$.	600772
ZHUR STRUKT KHIM 1, NO 2, 170 (1960)	600772
CA 55, 12987 (1961)	600772
MARKOVSKII, L Y	301530
(INST APPLIED CHEM Leningrad RUSSIA)	301530
CHEMICAL STABILITY AND STRUCTURE OF BORIDES	301530
POROSHKOVAYA MET AKAD NAUK UKR SSR 2, NO 4, 39 (1962)	301530
CA 51, 11617D	301530
CA 58, 1149C (1963)	301530
MAKIN, B BELL, I	601286
(CULCHETH LABS RES + DEV ENGLAND)	601286
FAST REACTOR-PHYSICAL PROPERTIES OF MATERIALS OF	601286
CONSTRUCTION REV OF PROGRESS FROM SEPT 1, 1953-APR 1, 1954	601286
RDB (C)/TN-70 (1954)	601286
NSA 9, 1266 (1955)	601286
MAKKAY, R W FINE, M E	301298
(NORTHWESTERN UNIV EVANSTON ILL)	301298
VACUUM REDUCTION OF ALPHA- NP_{2O5} AT LOW TEMPERATURES	301298
J APPL PHYS 33, 745 (1962)	301298
JACS 79, 2039 (1957)	301298
CA 58, 2963F (1963)	301298
MAKSIMOVA, I N	202094
(LENSOVET TECHNOL INST Leningrad RUSSIA)	202094
IONIZATION POTENTIALS AND HEATS OF FORMATION OF COMPOUNDS	202094
ZH STRUKT KHIM 3 (2), 208 (1962)	202094
CA 59, 8135C (1963)	202094
MALINCHKOV, O POVITSKII, V	300947
INVESTIGATION OF TRANSITION METAL BORIDES AND PURE BORON BY	300947

NUCLEAR MAGNETIC RESONANCE POROSH MET 2, NO 4, 26 (1962)	300947 300947
MALINCHKOV, O POVITSKII, V INVESTIGATING CRB, LAB6 AND CRYSTALLINE BORON BY THE METHOD OF NUCLEAR MAGNETIC RESONANCE FIZ MET I METALLOVED 13, NO 6, 933 (1962)	300948 300948 300948 300948
MALLET, M GERDS, A (BATTELLE MEMORIAL INST COLUMBUS OHIO) REACTION OF NITROGEN WITH URANIUM J ELECTROCHEM SOC 102, 292 (1955) CA 50, 657 (1956)	600986 600986 600986 600986 600986
MALLET, M GERDS, A NELSON, H THE URANIUM-CARBON SYSTEM J ELECTROCHEM SOC 99, 197 (1952) CA 47, 11064 (1953)	100188 100188 100188 100188
MALLET, M GERDS, A VAUGHAN, D URANIUM SESQUICARBIDE J ELECTROCHEM SOC 98, 505 (1951) AECD-3060 BMI-T-19 (1950) CA 47, 2073 (1953) NSA 5, 2767 (1951)	100203 100203 100203 100203 100203 100203
MALM, J SELIG, H (ARGONNE NATL LAB LEMONT ILL) J INORG NUCLEAR CHEM 20, 189 (1961) VAPOR PRESSURES AND OTHER PROPERTIES OF REF6 AND REF7 CA 56, 13561 (1962)	201502 201502 201502 201502 201502
MALTSEV, V GAGARINSKII, Y POPOV, M HEAT OF FORMATION OF URANIUM TETRAFLUORIDE ZHUR NEORG KHIM 5, 228 (1960) CA 55, 21776 (1961)	201161 201161 201161 201161
MALTSEV, A MATVEEV, V TATEVSKII, V (MOSCOW STATE UNIV MOSCOW RUSSIA) THE NATURE OF THE FLUCTUATING BANDS OF BORIC ACID DANSSSR 137, NO 1, 123 (1961)	300949 300949 300949 300949
MALTSEV, A KATAEV, D TATEVSKII, V AN INVESTIGATION OF THE ELECTRONIC SPECTRA AND THE ISOTOPIC SHIFT OF COMPOUNDS OF BORON AND OXYGEN III GAMMA BANDS OF THE B ₂ MOLECULE OPTIKA I SPEKTROSK 9, 713 (1960) PA 64, 4938 (1961)	600701 600701 600701 600701 600701 600701
MALTSEV, A KUZYAKOV, Y TATEVSKII, V STUDY OF THE ELECTRON SPECTRA AND THE ISOTOPE EFFECT IN OXYGEN COMPOUNDS OF BORON. I. B-BANDS OF THE B ₂ MOLECULE FIZ SBORNIK LVOV U 3, 475 (1957) CA 55, 21788 (1961)	300316 300316 300316 300316 300316
MALTSEV, A TATEVSKY, V INTERPRETATION OF THE INFRARED SPECTRA OF BORON TRIOXIDE AND BORON TRISULFIDE MOLECULES OPTIKA I SPEKTROSKOPIYA 10, 564 (1961) PA 65, NO 1998, (1962)	700604 700604 700604 700604 700604
MALYUCHKOV, O T POVITSKII, V A (MOSCOW STEEL INST MOSCOW RUSSIA)	202095 202095

INVESTIGATION OF BORIDES OF TRANSITION METALS AND PURE BORON BY THE METHOD OF NUCLEAR MAGNETIC RESONANCE	202095
POROSHKOVAIA MET AKAD NAUK UKR SSR NO 4, 26 (1962)	202095
NSA 17, 8081 (1963)	202095
FIZ METAL METALLOVED 13, 676 (1962)	202095
MALYUCHKOV, O POVITSKII, V	300584
STUDY OF CHROMIUM BORIDE, LANTHANUM BORIDE AND CRYSTALLINE BORON BY NUCLEAR MAGNETIC RESONANCE	300584
FIZ METAL I METALLOVED 13, NO 6, 933 (1962)	300584
CT NO 17, 78 (1962)	300584
MANAKOV, A I ESIN, O A LEPINSKIKH, B M	202096
THERMOELECTROMOTIVE FORCE AND ELECTRICAL CONDUCTANCE OF VANADIUM AND NIOBIUM PENTOXIDES	202096
ZH FIZ KHIM 36, 2734 (1962)	202096
CA 58, 8485H (1963)	202096
MANDELBERG, C DAVIS, D	201335
(AT ENERGY RES ESTAB HARWELL ENGLAND)	201335
REACTION OF UF ₄ WITH OXYGEN	201335
CA 56, 5622 (1962)	201335
J INORG AND NUCLEAR CHEM 20, 58 (1961)	201335
MANDIL, I SCOTT, R	201303
(US AT ENERGY COMM WASHINGTON DC)	201303
URANIUM DIOXIDE AND ITS APPLICATION TO NUCLEAR POWER REACTORS	201303
CA 56, 4343 (1962)	201303
MANNAS, D SMITH, J	201786
(GEN ELEC CO CINCINNATI OHIO)	201786
BERYLLIUM INTERMETALLIC COMPOUNDS, THEIR PREPARATION AND FABRICATION	201786
J METALS 14, 575 (1962)	201786
CA 57, 8291 (1962)	201786
MARADUDIN, A FLINN, P HORSFALL, R	301085
ANHARMONIC CONTRIBUTIONS TO VIBRATIONAL THERMODYNAMIC PROPERTIES OF SOLIDS. I. GENERAL FORMULATION AND APPLICATION TO THE LINEAR CHAIN	301085
ANN PHYS (USA) 15, 337 (1961)	301085
PA 65, 568 (1962)	301085
MARADUDIN, A FLINN, P COLDWELL-HORSFALL, R	301084
ANHARMONIC CONTRIBUTIONS TO VIBRATIONAL THERMODYNAMIC PROPERTIES OF SOLIDS. II. THE HIGH TEMPERATURE LIMIT	301084
ANN PHYS 15, 360 (1961)	301084
PA 65, 569 (1962)	301084
MARCHAL, M TROUVE, J	900202
STUDY OF THE SYSTEM CARBON-URANIUM-THORIUM	900202
CEA-3677	900202
AEC-TR-5174	900202
MARCINKOWSKI, M LIPSITT, H	600861
ELECTRICAL RESISTIVITY OF CHROMIUM IN THE VICINITY OF THE NEEL TEMPERATURE	600861
J APPL PHYS 32, NO 7 1238 (1961)	600861
PA 64, 10024 (1961)	600861
MARCUS, R	200863
(STANFORD RESEARCH INST MENLO PARK CALIF)	200863
GRAPHIC ESTIMATION OF ENERGIES OF VAPORIZATION	200863

IND ENG CHEM 52, 938 (1960)		200863
CA 55, 5108 (1961)		200863
MARDEN, J RENTSCHLER, H		900119
METALLIC THORIUM		900119
IND ENG CHEM 19, 97 (1927)		900119
CA 21, 841 (1927)		900119
MARDON, P NICHOLS, J PEARCE, J POOLE, D		200987
(AT ENERGY RESEARCH ESTAB HARWELL	ENGLAND)	200987
SOME PROPERTIES OF SCANDIUM METAL		200987
NATURE 189, 566 (1961)		200987
CA 55, 12215 (1961)		200987
MARGOTIN, P DURAND, R		201863
(ESTAB KUHLMANN	LEVALLØIS-PERRET FRANCE)	201863
DETERMINATION OF METAL PURITY BY MEASURING THE RESISTIVITY AT		201863
LOW TEMPERATURES		201863
MEM SCI REV MET 59, 255 (1962)		201863
CA 57, 12217 (1962)		201863
MARGOTIN, P STUCKENS, W DURAND, R		201574
(LAB CENTRAL RESEARCHES	LEVALLØIS FRANCE)	201574
REGIONS OF THERMAL STABILITY OF DIFFERENT OXIDES OF URANIUM		201574
IN THE PRESENCE OF OXYGEN AND HYDROGEN		201574
COMPT REND 252, 4005 (1961)		201574
CA 57, 372 (1962)		201574
MARGRAVE, J		300472
(UNIV OF WISCONSIN	MADISON WISC)	300472
CHEMISTRY AT HIGH TEMPERATURES		300472
SCIENCE 135, 345 (1962)		300472
BHTG NO 4, 13 (1962)		300472
MARGRAVE, J		301531
STUDIES OF HIGH TEMPERATURE SYSTEMS		301531
AD 275, 797 (1961)		301531
MARGRAVE, J		700967
(UNIV OF WISCONSIN	MADISON WISC)	700967
PROPERTIES OF MATERIALS AT HIGH TEMPERATURES		700967
TID-13678 (1961)		700967
NSA 15, 32549 (1961)		700967
MARIN, J		601571
(CIT	PASADENA CAL)	601571
TRANSITIONS IN CHROMIUM		601571
TID-14740		601571
NSA 16, 10542 (1962)		601571
MARINCHUK, A E MOSKALENKO, V A		202092
(INST PHYS AND MATH ACAD SCI KISHINEV	USSR)	202092
THE THERMODYNAMICS OF CRYSTAL LATTICE		202092
FIZ TVERD TELA 5 (2), 575 (1963)		202092
CA 59, 82046 (1963)		202092
MARINDER, B		700649
(UNIV OF STOCKHOLM	STOCKHOLM SWEDEN)	700649
NOTE ON THE CRYSTAL STRUCTURE OF NIOBIUM DIOXIDE		700649
ACTA CHEM SCAND 15, 707 (1961)		700649
NSA 15, 27514 (1961)		700649
MARINDER, B		601678

(UNIV STÖCKHÖLM CRYSTAL STRUCTURE OF Nb ₂ O ₅ ARKIV KEMI 19, 435 (1962) BHT N° 4, (1962)	STÖCKHÖLM	SWEDEN)	601678 601678 601678 601678
MARKEVICH, G KONDRAŠEV, Y MARKOVSKII, L (STATE INST OF APPLIED CHEMISTRY ON THE NEW BORIDE PHASE IN BERYLLIUM BORON SYSTEMS ZHUR NEORG KHIM 5, 1783 (1960) NS 14, 25489 (1960)		USSR)	600630 600630 600630 600630 600630
MARKEVICH, G MARKOVSKII, L CHEMICAL STABILITY OF BERYLLIUM BORIDES WITH RESPECT TO O ₂ , N ₂ AND C AT HIGH TEMPERATURES UCRL-TRANS-628 NSA 15, 10944 (1961)			700917 700917 700917 700917 700917
MARKEVICH, G MARKOVSKII, L CHEMICAL STABILITY OF BERYLLIUM BORIDES IN OXYGEN, NITROGEN, AND CARBON AT HIGH TEMPERATURES ZHUR PRIKLAD KHIM 33, 1008 (1960) AEC-TR-4595 NSA 15, 17258 (1961)			700937 700937 700937 700937 700937 700937
MARKEVICH, G MARKOVSKII, L PHASE COMPOSITION OF THE SYSTEM Be-B TRUDY GOSUDARST INST PRIKLAD KHIM 1960, N° 45, 139 CA 56, 5443 (1962)			201315 201315 201315 201315
MARKIN, T BONES, R (ATOMIC ENERGY RES ESTAB HARTWELL ENGLAND) A DETERMINATION OF CHANGES IN FREE ENERGY FOR URANIUM OXIDES USING A HIGH TEMPERATURE GALVANIC CELL I REPT AFRE-R 4042 (1962) CA 57, 10592 (1962)			201819 201819 201819 201819 201819 201819
MARKIN, T ROBERTS, L WALTER, A THERMODYNAMIC DATA FOR THE URANIUM OXIDES BETWEEN UO ₂ AND U ₃ O ₈ IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS, VIENNA, MAY (1962) NSA 16, 25377 (1962)			601608 601608 601608 601608 601608 601608
MARKIN, E SOBOL'EV, N INFRARED REFLECTION SPECTRUM OF BORIC ANHYDRIDE AND FUSED QUARTZ AT HIGH TEMPERATURES OPTIKA I SPEKTROSKOPIYA 9, 587 (1960) CA 55, 12050 (1961)			200979 200979 200979 200979 200979
MARKOVSKII, L Y (LENINGRAD STATE INST APP CH LENINGRAD RUSSIA) CHEMICAL STABILITY AND STRUCTURE OF BORIDES POROSHKOVAIA MET AKAD NAUK UKR SSR N° 4, 39 (1962) NSA 17, 8083 (1963)			202098 202098 202098 202098 202098
MARKOVSKII, L KAPUTOVSKAYA, G CHEMICAL PROPERTIES OF MAGNESIUM BORIDES AND THEIR ROLE IN THE PREPARATION OF BORON BY THE MAGNESIUM-THERMAL METHOD ZH PRIKL KHIM 35, 723 (1962) CA57, 5553 (1962)			201722 201722 201722 201722 201722
MARKOVSKII, L VEKSHINA, N PRON, G FORMATION OF BOROCARBIDES IN THE REDUCTION OF MIXTURES OF			201986 201986

RUSS ACC 15, 444 (1962)	300357
MARTYNKEVICH, G	300554
MECHANISM OF VAPORIZATION AND CONDENSATION	300554
IZV AKAD NAUK SSSR OTD TEKH NAUK MET I TÖPLIVÖ	300554
NÖ 3, 142 (1961)	300554
BHT NÖ 2, 51 (1962)	300554
MARYÖTT, A KRYDER, S	600748
(NATL BUREAU OF STDS WASH 25 D C)	600748
NONRESONANT MICROWAVE ABSORPTION AND ELECTRIC DIPOLE MOMENT	600748
OF NÖ IN THE GASEOUS STATE	600748
J CHEM PHYS 31, 617 (1959)	600748
CA 54, 10502 (1960)	600748
MASLAN, F	601354
NUCLEAR ENG DEPT PROG REPT FOR JAN 1- APRIL 30, 1959	601354
BNL-571	601354
NSA 14, 8325 (1960)	601354
MASLÖV, P	300745
DETERMINATION OF THE HEATS OF COMBUSTION OF NITROGEN AND	300745
OXYGEN-CONTAINING ORGANIC COMPOUNDS	300745
KHIM PROM NÖ 3, 185 (1962)	300745
MASLÖV, P MASLÖV, Y	300658
A NEW STATISTICAL METHOD FOR CALCULATING THERMODYNAMIC	300658
PROPERTIES	300658
KHIM I PRAKT PRIMENENIE KREMNEORGAN SÖEDIN	300658
TR KONF LENINGRAD 1958, NÖ 6, 240 (1961)	300658
CA 56, 13624 (1962)	300658
MASLÖV, P MASLÖV, Y	601196
(MECH INST LENINGRAD USSR)	601196
THERMODYNAMIC PROPERTIES OF COMPOUNDS CONTAINING LANTHANIDES	601196
IZVEST VYSSHIKH UCHEB ZAVEDENII KHIM I KHIM TEKHNO	601196
2, 516 (1959)	601196
CA 54, 6290 (1960)	601196
MASLÖV, P G	202099
HEATS OF FORMATION OF CERTAIN BORON CONTAINING	202099
COMPOUNDS IN THE LIQUID PHASE	202099
ZH ÖBSHCK KHIM 33, 1054 (1963)	202099
MASLÖV, P MASLÖV, Y	700538
METHOD OF CALCULATING THERMODYNAMIC PROPERTIES WITHOUT	700538
KNOWLEDGE OF ELECTRONIC AND VIBRATION SPECTRA	700538
ZHUR FIZ KHIM 35, 164 (1961)	700538
MASÖN, S	201224
(UNIV EXETER EXETER ENGLAND)	201224
MOLECULAR ELECTRONIC ABSORPTION SPECTRA	201224
QUART REVS (LÖNDÖN) 15, 287 (1961)	201224
CA 56, 1046 (1962)	201224
MASSAZZA, F	201293
(UNIV CAGLIARI ITALY)	201293
THE TERNARY SYSTEM BEÖ-TIÖ2-MGÖ	201293
ANN CHIM (RÖME) 51, 78 (1961)	201293
CA56, 4147 (1962)	201293
MASSÖNNE, J	201425
(KALI-CHEM A-G HANÖVER GERMANY)	201425

METHODS FOR THE PRODUCTION OF PURE SCANDIUM OXIDE	201425
J PRAKT CHEM 14, 305 (1961)	201425
CA 56, 9682 (1962)	201425
MATLOW, S	300401
THREE DIMENSIONAL FE-MO MODEL. I. DELTA H OF DISSOCIATION OF	300401
HOMONUCLEAR DIATOMIC MOLECULES	300401
J CHEM PHYS 34, NO 4 1187 (1961)	300401
PA 64, 6035 (1961)	300401
MATOSSE, F	301299
(UNIV FREIBURG BREISGAU GERMANY)	301299
THE VIBRATION SPECTRUM OF RUTILE	301299
Z PHYSIK 173, 1 (1963)	301299
CA 59, 2292H (1963)	301299
MATSKEVICH, T KAZANTSEV, A KRACHIN, T	300952
THERMO ELECTRON EMISSION OF HAFNIUM BORIDES, HAFNIUM	300952
CARBIDE, HAFNIUM OXIDE, VANADIUM CARBIDE, AND SOLID	300952
SOLUTION URANIUM CARBIDE (1)-ZIRCONIUM CARBIDE (4)	300952
ZH TEKHN FIZ 32, NO 10, 1266 (1962)	300952
MATSKEVICH, T KRACHIN, T KAZANTSEV, A	301533
TAB2 FIELD EMISSION	301533
RADIOTEKHNIKA I ELEKTRON 7, NO 11, 1972 (1962)	301533
CA 58, 7467 (1963)	301533
MATSUURA, R	201028
(MITSUBISHI CHEM IND CO LTD KAWASSKI JAPAN)	201028
VANADIUM PENTOXIDE CATALYST. I. REDUCTION OF VANADIUM	201028
PENTOXIDE BY A STATIC METHOD	201028
NIPPON KAGAKU ZASSHI 82, 276 (1961)	201028
CA 55, 14024 (1961)	201028
MATTERSON, K JONES, H	300324
A STUDY OF THE TETRA-BORIDES OF URANIUM AND THORIUM	300324
TRANS BRIT CERAM SOC 60, 475 (1961)	300324
BHT 4, 9 (1961)	300324
MATTHIAS, B	300945
(BELL TELEPHONE LABS MURRAY HILL NJ)	300945
CONCLUSIONS FROM SUPERCONDUCTING MOLYBDENUM TECHNETIUM ALLOYS	300945
REV MODERN PHYSICS 33, 499 (1961)	300945
MATVEEV, V MALTSEV, A TATEVSKII, V	300775
INTENSITY DEPENDENCE OF THE FLUCTUATION BANDS OF BORIC ACID	300775
ON THE OXYGEN PRESSURE	300775
VESTN MOSK UNIV KHIM SER II 16, NO 1, 51 (1961)	300775
CA 56, 12438 (1962)	300775
MATVEEVA, M IVANOV, L BYSTROV, L	200892
RELATION BETWEEN THERMODYNAMIC CONSTANTS AND THE STRENGTH	200892
OF ALLOYS AT HIGH TEMPERATURES	200892
ISSLEDOVANIYA PO ZHAROPROCH SPLAVAM, AKAD NAUK SSSR	200892
INST MET IM AA BAIKOVA 3, 50 (1958)	200892
CA 55, 6325 (1961)	200892
MATYUSHENKO, N VERKHOROBIN, V PUGACHEV, N SIVOKON, N	301150
(PHYS TECH INST ACAD SCI UKR SSR)	301150
CRYSTAL STRUCTURE OF HIGHER BERYLLIDES OF MO, W AND RE	301150
KRISTALLOGRAFIYA 7, (6) 862 (1962)	301150
BHT NO 1, 9 (1963)	301150

MAY, C HØEKSTRA, P STABILITY ØF REFRACTØRY CØMPØUNDS IN HYDRØGEN BETWEEN 4500 AND 5000 DEGREES F, AND THEIR CØMPATIBILITY WITH TUNGSTEN AD-257063 (MAY 1961) GR 36, NØ 3, 47 (1961)	700663 700663 700663 700663 700663
MAY, C KØNEVAL, D FRYBURG, G STABILITY ØF CERAMICS IN HYDRØGEN BETWEEN 4000 AND 4500 DEGREES F NASA MEMØ 3-5-59E (1959) CERAM ABS 44, 197 (1961)	700686 700686 700686 700686 700686
MAYER, J HEAT CAPACITY AND ØPEN AND CLØSED ENSEMBLE AVERAGES J PHYS CHEM 66, 591 (1962)	300397 300397 300397
MAYKUTH, D ØGDEN, H JAFFEE, R (BATTTELLE MEM INST CØLUMBUS ØHIØ) THE EFFECTS ØF ALLØYING ELEMENTS IN T1 DMIC-136A (1960) NSA 15, 4281 (1961)	700983 700983 700983 700983 700983
MAZØ, R M (UNIV ØF ØREGØN EUGENE ØREGØN) FREE ENERGY ØF A SYSTEM WITH RANDØM ELEMENTS J CHEM PHYS 39 (5), 1224 (1963) CA 59, 7007G (1963)	202100 202100 202100 202100 202100
MCBRIDE, B GØRDØN, S THERMØDYNAMIC FUNCTIONS ØF SEVERAL TRIATØMIC MØLECULES IN THE IDEAL GAS STATE J CHEM PHYS 35, 2198 (1961) BHTG NØ 4, 13 (1962)	300473 300473 300473 300473 300473
MCCABE, C THE STANDARD FREE ENERGY ØF FØRMATION ØF CERTAIN RARE EARTH CARBIDES NYØ 7432 (1960) US GØV REPØRTS 35, 649 (1961)	700599 700599 700599 700599 700599
MCCALDIN, J DUWEZ, P (CAL INST TECH CALIFØRNIA) ALLØTROPIC TRANSFØRMATIONS AT HIGH TEMPERATURE J TRANS MET AIME 200, 619 (1954) CA 48, 6797 (1954) NSA 8, 4070 (1954)	600956 600956 600956 600956 600956
MCCARLEY, R BRØWN, T (IØWA STATE UNIV AMES IØWA) TUNGSTEN TRIBRØMIDE AND TUNGSTEN TETRABRØMIDE J AM CHEM SØC 84, 3216 (1962) CA 57, 12082 (1962)	201856 201856 201856 201856 201856
MCCLAIN, L THERMØDYNAMIC AND KINETIC STUDIES FØR A REFRACTØRY MATERIALS PRØGRAM FIRST SEMIANNUAL PRØGRESS REPØRT 5 JULY TØ 31 DECEMBER 1960 CØNTRACT AF33(161) 7472 TASK 73500	300278 300278 300278 300278 300278
MCCLOSKEY, A BØØNE, J BRØTHERTØN, R (U S BØRAX ANAHEIM CALIF) THE PREPARATION ØF DIBØRØN TETRACHLØRIDE FØRM BØRØN MØNXIDE J AM CHEM SØC 83, 1766 (1961)	201033 201033 201033 201033

CA 55, 14144 (1961)	201033
MCCULLOUGH, R GLÖCKLER, G	600727
(STATE UNIV OF IOWA IOWA CITY IOWA)	600727
THE ELECTRONIC EMISSION SPECTRUM OF C13016	600727
PHYS REV 89, 145 (1953)	600727
CA 47, 4733 (1953)	600727
MCCULLOUGH, R	301151
(LINDE DEVEL LAB NEWARK N J)	301151
PLASMARC FURNACE A NEW CONCEPT IN MELTING METALS	301151
J METALS 14, (12) 907 (1962)	301151
BHT NO 1, 1 (1963)	301151
MCDONALD, J	300664
THERMODYNAMIC STUDIES ON COMPOUNDS OF RHENIUM	300664
DISS ABST 22, 2183 (1962)	300664
MCDONALD, R SINKE, G STULL, D	300662
(DOW CHEM CO MIDLAND MICH)	300662
HIGH TEMPERATURE ENTHALPY, HEAT CAPACITY, HEAT OF FUSION,	300662
AND MELTING POINT OF ZIRCONIUM TETRAFLUORIDE	300662
J CHEM ENG DATA 7, NO 1, 83 (1962)	300662
CA 57, 1632 (1962)	300662
MCDONALD, R STULL, D	300333
THE HEAT CONTENT AND HEAT CAPACITY OF BORON NITRIDE FROM	300333
298 TO 1689 DEG K	300333
J PHYS CHEM 65, 1918 (1961)	300333
BHT 4, 22 (1961)	300333
MCDONALD, R STULL, D	300726
(DOW CHEM CO MIDLAND MICH)	300726
HEAT CONTENT AND HEAT CAPACITY OF CRYSTALLINE BORON FROM	300726
298 TO 1700 DEGREES K	300726
J CHEM ENG DATA 7, 84 (1962)	300726
CA 57, 2931 (1962)	300726
MCDOWELL, C	201370
(UNIV BRIT COLUMBIA VANCOUVER CANADA)	201370
MASS SPECTROMETRY	201370
METHODS EXPTL PHYS (D WILLIAMS ED, ACADEMIC PRESS) 3, 525	201370
(1962)	201370
CA 56, 8015 (1962)	201370
MCDOWELL, R S	301300
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	301300
CENTRIFUGAL DISTORTION CORRECTIONS TO CALCULATED THERMODYNAMIC	301300
FUNCTIONS	301300
J CHEM PHYS 39, (3) 526 (1963)	301300
CA 59, 4595C (1963)	301300
MCGONIGAL, P KIRSHENBAUM, A GRÖSSE, A	201532
(TEMPLE UNIV PHILADELPHIA PA)	201532
THE LIQUID TEMPERATURE RANGE DENSITY AND CRITICAL CONSTANTS OF	201532
MAGNESIUM	201532
J PHYS CHEM 66, 737 (1962)	201532
CA56, 14946 (1962)	201532
MCGREGOR, A NICHOLLS, R JARMAIN, W	300475
FRANCK-CONDON FACTORS AND R CENTRIDS FOR SOME BANDS OF	300475
THE SiO BAND SYSTEM	300475
CAN J PHYS 39, 1215 (1961)	300475

BHTG NO 4, 16 (1962)	300475
MCHARGUE, C YAKEL, H	600646
PHASE TRANSFORMATIONS IN CERIUM	600646
ACTA MET 8, 637 (1960)	600646
CA 55, 3368 (1961)	600646
NS 15, 1863 (1961)	600646
MCKENZIE, D JENKINSON, W	700805
VOLATILIZATION OF PLUTONIUM FROM NEUTRON IRRADIATED URANIUM	700805
ATOMIC ENERGY CANADA LTD CHALK RIVER, ONT AECL-788 (1960)	700805
CA 54, 23908 (1960)	700805
MCKEOWN, J	601080
(STATE UNIV OF IOWA IOWA CITY IOWA)	601080
HIGH-TEMPERATURE HEAT CAPACITY AND RELATED THERMODYNAMIC	601080
FUNCTIONS OF RARE EARTH METALS	601080
UNIV. MICROFILMS, LC CARD NO.	601080
MIC 58-2194, DISSERTATION ABSTR 19, 57 (1958)	601080
CA 52, 16855 (1958)	601080
MCKINSEY, C MINCHER, A SHEELY, W WILSON, J	201949
(UNION CARBIDE CORP NIAGARA FALLS N Y)	201949
TUNGSTEN-TANTALUM-NIOBIUM BASE ALLOYS	201949
US DEPT COM OFFICE TECH SERV AD 267, 386, (1961)	201949
CA 57, 16272 (1962)	201949
MCLAREN, M	301534
(RUTGERS UNIV NEW BRUNSWICK NJ)	301534
EFFECTS OF DIFFERENT PREPARATION METHODS OF TITANIUM	301534
MONOXIDE ON ITS ELECTRICAL PROPERTIES	301534
CA 58, 7457 (1963)	301534
MCMASTERS, O PALMER, P LARSEN, W	301535
(IOWA STATE UNIV AMES IOWA)	301535
THORIUM-MOLYBDENUM PHASE DIAGRAM	301535
J NUCL MATER 7, 151 (1962)	301535
CA 58, 13547 (1963)	301535
MCMASTERS, O LARSEN, W	600834
PHASE EQUILIBRIA IN THE THORIUM TANTALUM SYSTEM	600834
J LEM COMMON METALS 3, 312 (1961)	600834
MCNALLY, J	100211
(OAK RIDGE NATL LAB OAK RIDGE TENN)	100211
ATOMIC SPECTROSCOPY OF SEPARATED ISOTOPES	100211
AM J PHYS 20, 152 (1952)	100211
CA 47, 38 (1953)	100211
MCNALLY, J	400523
THE CLASSIFICATION OF THE SPECTRUM OF SINGLY IONIZED URANIUM	400523
PHYS REV 77, 417 (1950)	400523
J OPTICAL SOC AM 39, 636A (1949)	400523
Y-494, OCT 12, (1949)	400523
CA 44, 3350 (1950)	400523
NSA 4, 1419 (1950)	400523
MCNALLY, R PETERS, F RIBBE, P	600828
LABORATORY FURNACE FOR STUDIES IN CONTROLLED ATMOSPHERES	600828
MELTING POINTS OF MgO IN N2 ATMOSPHERE AND OF Cr2O3 IN N2	600828
AND IN AIR ATMOSPHERE	600828
J AM CERAM SOC 44, 491 (1961)	600828

MCQUEEN, R MARSH, S	200777
(LOS ALAMOS SCI LAB LOS ALAMOS N MEX)	200777
EQUATION OF STATE FOR 19 METALLIC ELEMENTS FROM SHOCK-WAVE	200777
MEASUREMENTS TO TWO MEGABARS	200777
J APPL PHYS 31, 1253 (1960)	200777
CA 55, 42 (1961)	200777
MCTAGGART, F K	202101
NEW PROTON--CONTAINING OXIDES OF TITANIUM ZIRCONIUM AND	202101
HAFNIUM	202101
NATURE 199, 339 (1963)	202101
CT NO 17, 113 (1963)	202101
MCTAGGART, F	300338
REDUCTION OF ZIRCONIUM AND HAFNIUM OXIDES	300338
NATURE 191, 1192 (1961)	300338
BHT 4, 43 (1961)	300338
MEDVEDEV, V	300335
DISSOCIATION ENERGIES AND HEATS OF SUBLIMATION OF THE	300335
ALKALINE EARTH OXIDES	300335
DOKLADY AKAD NAUK SSSR 139, 1481 (1961)	300335
BHT 4, 25 (1961)	300335
MEDVEDEV, V	300253
(INST FUEL RAW MATERIALS MOSCOW RUSSIA)	300253
DISSOCIATION ENERGIES AND HEATS OF SUBLIMATION OF THE OXIDES	300253
OF ALKALINE EARTH METALS	300253
ZHUR FIZ KHIM 35, 1481 (1961)	300253
CA 56, 2044 (1962)	300253
MEERSON, G	300298
REDUCTION BY HEATING OXIDES OF REFRACTORY METALS WITH CARBON	300298
IN VACUO	300298
PRIMENEN VAKUUMA V MET AKAD NAUK SSSR INST MET IM AA	300298
BAIKOVA 115 (1960)	300298
CA 55 16315 (1961)	300298
MEERSON, G	300950
(MOSCOW STATE UNIV MOSCOW RUSSIA)	300950
THEORY OF TITANIUM DIOXIDE REDUCTION WITH CARBON	300950
RUSS MET AND FUELS NO 3, 27 (1962)	300950
IZV ANSSSR OTN MET I TOP NO 3, 33 (1962)	300950
MEERSON, G DERGUNOVA, V EPELBAUM, V GUREVITCH, M	300373
STUDY OF SOME HARD ALLOYS OF THE B-SI-C SYSTEM	300373
IZVEST AKAD NAUK SSSR 4, 90 (1961)	300373
BHT NO 1, 9 (1962)	300373
MEERSON, G KREIN, O	200831
PREPARATION OF HAFNIUM CARBIDE	200831
ZHUR NEORG KHIM 5, 1164 (1960)	200831
CA 55, 3257 (1961)	200831
MEERSON, G SEGORCHEANU, T	300946
AFFINITY OF NIOBIUM WITH OXYGEN	300946
AT ENERGY (USSR) 13, NO 6, 597 (1962)	300946
MEERSON, G ZELIKMAN, A BELYAEVSKAYA, L TSEITINA, N	201912
KIRILLOVA, G	201912
THE CHLORINATION PROCESSES OF THE CARBIDES OF TITANIUM AND	201912
NIOBIUM, OF COMPLEX TITANIUM-NIOBIUM CARBIDE AND OF SOME	201912
OTHER COMPOUNDS	201912

TITAN I EGØ SPLAVY AKAD NAUK SSSR INST MET 1961, NØ 5, 167 (1961)	201912
CA 57, 14692 (1962)	201912
	201912
MEERSØN, G ZELIKMAN, A BELYAEVSKAYA, L TSEITINA, N	201007
KIRILLØVA, G	201007
(INST NØN-FERRØUS MEIALS KRSNØYARSK RUSSIA)	201007
CHLØRINATION ØF TITANIUM-NIØBIUM CARBIDES	201007
IZVEST VYSSHIXH UCHEØ ZAVEDENII TSVETNAYA MET 3, NØ 5, 108 (1960)	201007
CA 55, 13219 (1961)	201007
	201007
MEIJERING, J	700606
THERMØDYNAMICS ØF SILVER-PLATINUM SYSTEM	700606
PHYS AND CHEM SØLIDS 18, 267 (1961)	700606
MEINHARDT, D KRISEMENT, Ø	700912
(MAX-PLANCK INST DUSSELDØRF GERMANY)	700912
STRUCTURE INVESTIGATION ØF THE CHRØMIUM CARBIDE CR3C2 WITH	700912
THERMAL NEUTRØNS	700912
Z NATURFØRSCH 15A, 880 (1960)	700912
CA 55, 7978 (1961)	700912
NSA 15, 7818 (1961)	700912
MEIXNER, J	200824
(TECH HØCH SCHULE AACHEN GERMANY)	200824
RELAXATION PHENØMENA AND THEIR THERMØDYNAMIC	200824
INTERPRETATION	200824
NED TIJDSCHR-NATUURK 26, 259 (1960)	200824
CA 55, 3144 (1961)	200824
MELENTEV, B	200964
CØNDITIONS FØR THE PRØDUCTION ØF TITANIUM DIOXIDE	200964
IZVEST AKAD NAUK SSSR ØTDEL TEKH NAUK, MET I TØPLIVØ 1960,	200964
NØ 4, 69 (1960)	200964
CA 55, 11163 (1961)	200964
MEN, A ØRLØV, A	200794
THE BØND ENERGY ØF ØXIDES ØF TRANSITION METALS	200794
ISSLEDØVAN PØ ZHARØPRØCH SPLAVAM, AKAD NAUK SSSR, INST	200794
MET IM A A BAIKØVA 3, 364 (1958)	200794
CA 55, 1127 (1961)	200794
MENDELSSØHN, K RØSENBERG, H	201403
(CLARENDØN LAB ØXFØRD ENGLAND)	201403
THERMAL CØDUCTIVITY ØF METALS AT LØW-TEMPERATURES	201403
SOLID STATE PHYSICS 12, 223 (1961)	201403
CA 56, 9431 (1962)	201403
MENDENHALL, C INGERSALL, L	900143
THE MELTING PØINT ØF RHØDIUM AND IRIDIUM AND THE USE ØF THE	900143
NERNST GLØWER IN HIGH TEMPERATURE MEASUREMENTS	900143
PHYS REV 25, 1 (1907)	900143
CA 2, 7 (1908)	900143
MERRILL, P GREENSTEIN, J	601007
REVISED LIST ØF ABSØRPTION LINES IN THE SPECTRUM ØF	601007
R ANDRØMEDAE	601007
ASTRØPHYS J SUPPL SEV 2, 225 (1956)	601007
CA 50, 6183 (1956)	601007
MERRILL, P GREENSTEIN, J	601097
(MT WILSON ØBSERVATØRY PASADENA CALIF)	601097

DOUBLE ABSORPTION LINES IN THE SPECTRUM OF R ANDROMEDAE PUBLS ASTRON SOC PACIFIC 70, 98 (1958) CA 52, 8721 (1958)	601097 601097 601097
MERTSLIN, R V NIKURASHINA, N I KAMAEVSKAYA, L A PROPERTIES OF THE HETEROGENEOUS REGION IN TERNARY SYSTEMS INCORPORATING A DOMINANT BINARY SYSTEM RUSS J PHYS CHEM 36, 1351 (1963)	202102 202102 202102 202102
MERZ, K ADAMSKY, R SYNTHESIS OF THE WURTZITE FORM OF SILICON CARBIDE (JACS) J AM CHEM SOC 81 250 (1959)	202103 202103 202103
MERZ, A KOTSCH, H (FORSCHUNGSINST MET SPE DRESDEN GERMANY) CHROMIUM BORIDE MATERIALS ABHANDL DEUT AKAD WISS BERLIN KL MATH PHYSIK TECH 1962 NO 1, 423 (1962) CA 59, 2466H (1963)	301301 301301 301301 301301 301301 301301
MESNARD, G UZAN, R (UNIV LYON LYON FRANCE) CONDUCTIVITY AND OTHER ELECTRIC PROPERTIES OF THORIA LE VIDE 6, 1052 (1951) LE VIDE 6, 1091 (1951) CA 46, 2365 (1952) CA 46, 800 (1952)	400558 400558 400558 400558 400558 400558
METSON, G (POST OFFICE RES STA LONDON ENGLAND) THE CONDUCTIVITY OF OXIDE CATHODES THERMODYNAMIC CONSIDERATION OF MATRIX STABILITY PROC INST ELEC ENGRS 110, 845 (1963) CA 59, 5857 (1963)	301536 301536 301536 301536 301536
MEYER, G ØOSTERØM, J VAN ØEVEREN, W (LAB GEN INØRG CHEM DELFT NETHERLANDS) THE SYSTEM NBCL5-NB2Ø5 REC TRAV CHIM 80, 502 (1961) CA 56, 987 (1962)	201213 201213 201213 201213 201213
MEYERHØFF, R SMITH, J ANISØTROPIC THERMAL EXPANSION OF SINGLE CRYSTALS OF THALLIUM, YTTRIUM, BERYLLIUM, AND ZINC AT LOW TEMPERATURES J APPL PHYS 33, 219 (1962) PA 65, 2056 (1962)	300809 300809 300809 300809 300809
MEYERSON, G ET AL VACUUM THERMAL PRODUCTION OF BORIDES OF REFRACTORY METALS AND THE INVESTIGATION OF SOME BORIDE SYSTEMS SBØRNIK NAUCH TRUD MØS INST TSVET METAL I ZØLØTA NØ. 25, 209 (1955) CØTS 54, 116 (1962)	301122 301122 301122 301122 301122 301122
MEYERSON, G ET AL SOME PROPERTIES OF THE ALLOYS OF THE TIB2-CRØ2 TIB2-W2B5 AND ZRB2-CRØ2 SYSTEMS SBØRNIK NAUCH TRUGØV NAUCH TFKH ØØS TSVETNØI METAL I MØSKØV INST TSVET METAL I ZØLØTA NØ 29 323 (1959) CØTS 54, 241 (1962)	301115 301115 301115 301115 301115 301115
MEZAKI, R TILLEUX, E BARNES, D MARGRAVE, J (UNIV OF WISCØNSØN MADISON WISCØNSØN)	601617 601617

HIGH TEMPERATURE HEAT CONTENTS OF FIFTEEN REFRACTORY BORIDES IACA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS, VIENNA, MAY (1962) NSA 16, 25401 (1962)	601617 601617 601617 601617
MICHAELSON, H (PENNSYLVANIA ELECTRO PRODUCTS INC KEW GARDENS NEW YORK) WORK FUNCTIONS OF THE ELEMENTS J APPL PHYS 21, 536 (1950) CA 44, 8761 (1950)	400529 400529 400529 400529 400529
MICKELSON, R PETERSON, D (IOWA STATE COLLEGE AMES IOWA) SOLUBILITY OF CARBON IN THORIUM TRANS AM SOC METALS, PREPRINT NO 7 (1957) CA 51, 11798 (1957)	601057 601057 601057 601057 601057
MIESCHER, E (NATIONAL RESEARCH COUNCIL OTTAWA CANADA) FINE STRUCTURE OF NO+ AND NO EMISSION SPECTRA IN THE SCHUMANN REGION CAN J PHYSICS 33, 355 (1955) CA 49, 10054 (1955)	600749 600749 600749 600749 600749 600749
MIESCHER, E ROTATIONAL ANALYSIS OF THE BETA PRIME BANDS OF THE NITRIC OXIDE MOLECULE HELV PHYS ACTA 29, 401 (1956) CA 51, 17437 (1957)	600750 600750 600750 600750 600750
MIGEOTTE, P (UNIV LIEGE BELG) THE ULTRAVIOLET EMISSION SPECTRUM OF NO BULL SOC ROY SCI LIEGE 14, 40 (1945) CA 42, 6654 (1948)	600751 600751 600751 600751 600751
MIGEOTTE, P ROSEN, B (UNIV LIEGE BELG) PERTURBATIONS AND PREDISSOCIATION IN THE NO SPECTRUM BULL SOC RAY SCI LIEGE 14, 49 (1945) CA 42, 6654 (1948)	600752 600752 600752 600752 600752
MIGEOTTE, P ROSEN, B (UNIV LIEGE BELG) THE SPECTROSCOPIC STUDY OF THE NO MOLECULE BULL SOC ROY SCI LIEGE 19, 343 (1950) CA 45, 1868 (1951)	600753 600753 600753 600753 600753
MIKHAILOV, G PRONINA, I AKIMOVICH, O PRESNYAKOVA, G EXHAUSTING EFFECT AND EVAPORATION PROPERTIES OF METALLIC CR UNDER ELECTRON BOMBARDMENT UKRAIN FIZ ZHUR 6, 412 (1961) BHTG NO 4, 11 (1962)	300468 300468 300468 300468 300468
MIKHAILOVSKII, B I MARCHENKO, R I (STATE UNIV KIEV GERMANY) RATE AND PRODUCTS OF EVAPORATION OF THORIUM CARBIDE THERMOCATHODE RADIOTEKHNIKA I ELEKTRON 8, 680 (1963) CA 59, 4630B (1963)	301302 301302 301302 301302 301302 301302
MIKHAILOV, B SHCHEGOLEVA, T ORGANOBORON COMPOUNDS. COMMUNICATION 92. REFRACTIONS OF THE	900213 900213

BONDS OF BORON WITH SOME ELEMENTS IZ AK NAUK SSSR, OTDEL KHIM NAUK 1962, NO 3, 413 (1962) FTD-TT-62-1461	900213 900213 900213
MIKHEEV, V BELOUSOV, O FUSION DIAGRAM OF THE NIOBIUM-TITANIUM-ZIRCONIUM SYSTEM ZHURNOL NEORG KHIM NO 8, 972 (1961) COTS 56, 416 (1962)	300834 300834 300834 300834
MIKSIC, M G (POLYTECH INST OF BROOKLYN BROOKLYN N Y) ATOMIC THERMAL VIBRATIONS AND BONDING EFFECTS IN GRAPHITE DIAMOND AND TITANIUM DIBORIDE DISSERTATION ABSTR 23, 3429 (1963) CA 59, 2177F (1963)	301303 301303 301303 301303 301303 301303
MILLER, C MERTEN, U PORTER, J (GEN ATOMIC DIV GEN DYN CORP SAN DIEGO CALIF) CHEMISTRY OF URANIUM-OXYGEN SYSTEMS GA-1896, (1961) NSA 15, 24775 (1961)	601407 601407 601407 601407 601407
MILLER, F CARLSON, G (MELLON INST PITTSBURGH PA) VIBRATIONAL SPECTRA OF REO3CL AND REO3BR SPECTROCHIM ACTA 16, 1148 (1960) CA 55, 13054 (1961)	201002 201002 201002 201002 201002
MILLER, G PURIFICATION OF TANTALUM AND NIOBIUM IND CHEMIST 38, 406, 455 (1962) CA 57, 16265 (1962)	201943 201943 201943 201943
MILLER, G PRODUCTION OF TANTALUM AND NIOBIUM IND CHEMIST 36, 386 (1960) CA 55, 3362 (1961)	200834 200834 200834 200834
MILLER, K (ATOMICS INTERNATIONAL CANOGA PARK CAL) HIGH TEMPERATURE X-RAY DIFFRACTION INVESTIGATION OF BEC NAA-SR-5934 (1960) NSA 15, 19836 (1961)	700952 700952 700952 700952 700952
MILLER, S THE MICROWAVE ABSORPTION SPECTRUM OF OXYGEN UNIV MICRO. PUB NO. 4585 DISSERTATION ABS. 13, 108 (1953)	600560 600560 600560 600560
MILLER, S TOWNES, C (COLUMBIA UNIV NEW YORK NEW YORK) THE MICROWAVE ABSORPTION SPECTRUM OF (O16)2 AND O16O17 PHYS REV 90, 537 (1953) CA 47, 9778 (1953)	600559 600559 600559 600559 600559
MILLIGAN, W VERNON, L LEVY, H PETERSON, S (RICE INST HOUSTON TEXAS) NEUTRON DIFFRACTION STUDIES ON SCANDIUM ORTHOVANADATE AND SCANDIUM OXIDE J PHYS CHEM 57, 535 (1953) CA 47, 7886 (1953)	700756 700756 700756 700756 700756 700756
MILLS, I THOMPSON, H	600715

OXFORD UNIV	OXFORD	ENGLAND)	600715
FUNDAMENTAL VIBRATION ROTATION BANDS OF C13O16 AND C12O18			600715
TRANS FARADAY SOC 49, 224 (1953)			600715
CA 47, 9770 (1953)			600715
MILTER, S TOWNES, C KOTANI, M			600561
(COLUMBIA UNIV	NEW YORK	NEW YORK)	600561
THE ELECTRONIC STRUCTURE OF OXYGEN			600561
PHYS REV 90, 542 (1953)			600561
CA 47, 9749 (1953)			600561
MING, N FAN, T LI, C HSU, Y FONG, D			301304
(UNIV	NANKING	CHINA)	301304
PRODUCTION OF MOYLBDENUM SINGLE CRYSTALS WITH ELECTRON-BEAM			301304
FLOATING ZONE MELT			301304
WU LI HSUEH PAO 19 (3), 160 (1963)			301304
CA 59, 2231D (1963)			301304
MISENCIK, J			201432
(MIT	CAMBRIDGE	MASS)	201432
THE CHROMIUM-NIObIUM BINARY SYSTEM			201432
US DEPT COM OFFICE TECH SERV PB REPT 147,279, (1960)			201432
CA 56, 9833 (1962)			201432
MITKINA, E			201029
EXPERIMENTAL DETERMINATION OF TRUE SPECIFIC HEATS OF			201029
URANIUM, THORIUM, AND OTHER METALS			201029
AT ENERG USSR 7, 163 (1959)			201029
AEC-TR-3961			201029
CA 55, 14040 (1961)			201029
NSA 14, 6689 (1960)			201029
MITKINA, E A			301305
DETERMINATION OF HEAT CAPACITY USING AN ELECTRONIC CALORIMETER			301305
TEPL0-I MASSOPER 1 146-151 (1962)			301305
RUSS ACC VOL 16, NO 1, 151, APRIL (1963)			301305
CA 58, 13211 (1963)			301305
MITKINA, E A			301306
ELECTRONIC CALORIMETER			301306
ZAV LAB 26, 226 (1960)			301306
CA 56, 2298H (1962)			301306
MITOFF, S			201674
(GEN FLEC CO	SCHENECTADY	N Y)	201674
ELECTRONIC AND IONIC CONDUCTIVITY IN SINGLE CRYSTALS OF MG0			201674
J CHEM PHYS 36, 1383 (1962)			201674
CA57, 4141 (1962)			201674
MITRA, S JOSHI, S			700630
DEBYE THETA AND COMPRESSIBILITY. CUBIC METALS			700630
PHYSICA 27, 376 (1961)			700630
CT NO 13, (1961)			700630
MITROFANOV, O			301097
GROWING TUNGSTEN CRYSTAL FROM VAPORS			301097
KRISTALLOGRAFIYA 7, 780 (1962)			301097
MIYAMOTO, O NAKASHIMA, R ISHIGURO, Y OKUMURA, K			500118
(GOVT IND RES INST		NAGOYA)	500118
DETERMINATION OF OXYGEN IN METALLIC ZIRCONIUM BY A			500118
MICROBROMINATION METHOD			500118
NAGOYA KOGYO GIJUTSU SH I KENSHO HOKOKU 7, 322 (1958)			500118

CA 58, 16 (1963)	500118
MOFFITT, W	600539
(BRIT RUBBER PROD RES ASSOC WELWYN GARDEN CITY ENGLAND)	600539
THE ELECTRONIC STRUCTURE OF THE OXYGEN MOLECULE	600539
PROC ROY SOC LONDON A210, 224 (1951)	600539
CA 46, 10846 (1952)	600539
MONMA, K SUTO, H	201440
(TOHOKU UNIV SENDAI JAPAN)	201440
EXPERIMENTAL STUDIES ON THE SURFACE TENSION OF MOLTEN METALS	201440
AND ALLOYS	201440
TRANS JAPAN INST METALS 1, 69 (1960)	201440
CA 56, 9854 (1962)	201440
MONNIER, R GRANDJEAN, P	200949
(UNIV GENEVA GENEVA SWITZ)	200949
PREPARATION, SEPARATION, AND PURIFICATION OF TANTALUM AND NIO-	200949
BIUM, ESPECIALLY BY AN ELECTROLYTIC METHOD. II. A METHOD FOR	200949
DETERMINING EFFECTIVE ELECTROLYTIC POTENTIALS AND PRACTICAL	200949
DECOMPOSITION POTENTIALS. APPLICATION OF THIS METHOD TO	200949
SOLUTIONS OF OXIDES IN CRYOLITE	200949
HELV CHIM ACTA 43, 2163 (1960)	200949
CA 55, 10147 (1961)	200949
MONTGOMERY, H PELLIS, G	601447
(AERE HARWELL, BERKS ENGLAND)	601447
THE LOW TEMPERATURE SPECIFIC HEAT OF SCANDIUM AND YTTRIUM	601447
PROC PHYS SOC (LONDON) 78, 622 (1961)	601447
NSA 16, 1797 (1962)	601447
MONTGOMERY, R	601130
THERMODYNAMICS OF RARE EARTH COMPOUNDS	601130
US BUR MINES REPT INVEST NO 5468, 23 (1959)	601130
CA 53, 12815 (1959)	601130
MONTGOMERY, R HUBERT, T	700833
(U S BUR OF MINES RENO NEV)	700833
HEAT OF FORMATION OF YTTRIUM CHLORIDE	700833
CA 55, 2264 (1961)	700833
MORE, C	301538
(NATL BUR OF STDS WASHINGTON DC)	301538
ATOMIC SPECTRA OF THE RARE EARTHS. THEIR PRESENCE IN THE SUN	301538
APPL OPT 2, 665 (1963)	301538
CA 59, 5933 (1963)	301538
MORE, C	100200
ATOMIC-ENERGY LEVELS AS DERIVED FROM ANALYSIS OF OPTICAL	100200
SPECTRA	100200
NATL BUR STDS (US) CIRC 467, AT ENERGY LEVELS II, (1952)	100200
CA 47, 1491 (1953)	100200
MORE, C	100201
AN ULTRAVIOLET MULTIPLY TABLE	100201
US DEPT COMMERCE, NBS CIRCULAR 488, SECT 2 (1952)	100201
CA 47, 965 (1953)	100201
MORE, C	601088
ATOMIC ENERGY LEVELS AS DERIVED FROM THE ANALYSIS OF	601088
OPTICAL SPECTRA	601088
NATL BUR STDS CIRC 467 ATOMIC ENERGY LEVELS 3 (1958)	601088
CA 52, 11558 (1958)	601088

MØRE, C BRØDA, H	600687
(NATL BUR OF STANDARDS WASHINGTON D C)	600687
ROTATIONAL LINES OF CH ₂ O AND CN IN THE SOLAR SPECTRUM	600687
MEM SOC ROY SCI LIEGE 18, 252 (1957)	600687
CA 51, 15263 (1957)	600687
MØRE, G KELLEY, K	601646
HIGH TEMPERATURE HEAT CONTENTS OF U, UO ₂ AND UO ₃	601646
J AM CHEM SOC 69, 2105 (1947)	601646
MØRDIKE, B	300503
THE FRICTIONAL PROPERTIES OF CARBIDES AND BORIDES AT	300503
HIGH TEMPERATURES	300503
WEAR 3, 374 (1960)	300503
BHT NO 3, 25 (1961)	300503
MØREAU, C PHILIPPOT, J	201313
(CENTRE ETUDES NUCLEAIRES GRENOBLE FRANCE)	201313
THE NITRIDATION OF POWDERED URANIUM BY NITROGEN	201313
COMPT REND 253, 1100 (1961)	201313
CA56, 5434 (1962)	201313
MØRIARTY, J	200873
(STATE UNIV OF IOWA IOWA CITY IOWA)	200873
RARE EARTH METAL-ALLOY SYSTEMS	200873
UNIV MICROFILMS, L C CARD NO MIC 60-4395	200873
DISSERTATION ABSTR 21, 1391 (1960)	200873
CA 55, 5294 (1961)	200873
MØRIN, F	700710
OXIDES OF THE 3D TRANSITION METALS	700710
BELL SYST TECH JOUR 37, 1047 (1958)	700710
CA 52, 17971 (1958)	700710
MØRIN, F	201273
(BELL TELEPHONE LAB INC MURRAY HILL NJ)	201273
HALIDES, OXIDES AND SULFIDES OF THE TRANSITION METALS	201273
J APPL PHYS 32, 2195 (1961)	201273
CA 56, 2971 (1962)	201273
MØRIN, F MAITA, J	301043
(BELL TELEPHONE LABS MURRAY HILL NJ)	301043
SPECIFIC HEATS OF TRANSITION METAL SUPERCONDUCTORS	301043
PHYS REV 129, 1115 (1963)	301043
CA 58, 5055 (1963)	301043
MØRIYA, Y	201363
(TOKYO SHIBAURA ELEC CO LTD TOKYO JAPAN)	201363
VACUUM SINTERING OF QUARTZ POWDER AND PHASE TRANSFORMATION OF	201363
QUARTZ	201363
VACUUM 11, 158 (1961)	201363
CA56, 6921 (1962)	201363
MØRØZOV, I KØRSHUNOV, B	700753
THERMODYNAMICS OF CHLORINATION OF OXIDES OF RARE EARTH METALS	700753
BY GASEOUS CHLORINE	700753
DOKLADY AKAU NAUK SSSR 119, 523 (1958)	700753
NUCL SCI ABSTR 13, 15977 (1959)	700753
MØRØZOV, I STEFANYUK, S	200796
KINETICS OF THE CHLORINATION OF TiO ₂ AND Nb ₂ O ₅	200796
ZHUR NEORG KHIM 3, 2366 (1958)	200796

CA 55, 1153 (1961)	70796
MOROZOVA, M EGFR, G (STATE UNIV Leningrad Leningrad USSR	300247
THE ENTHALPIES OF FORMATION AND GRAM FORMULA VOLUMES OF THE LOWER OXIDES OF VANADIUM	300247
ZHUR OSHCHEI KHIM 30, NO 11 3514 (1960)	300247
J GEN CHEM 30, 3483 (1960)	300247
CA 55, 17189 (1961)	300247
MOROZOVA, M KHRIPUN, M ARIYA, S	300597
ENTHALPY OF FORMATION OF THE CARBIDES AND OXYCARBIDES OF TITANIUM	300597
ZHUR OSHCHEI KHIM 32, NO 7, 2072 (1962)	300597
MOROZOVA, M STOLYAROVA, T	300186
THE REASON FOR THE HEAT OF FORMATION OF NIOBIUM PENTOXIDE	300186
ZHUR OSHCHEI KHIM 30, NO 11 3848 (1960)	300186
J GEN CHEM 30, 3808 (1960)	300186
MOROZOVA, N STARTSEV, G	601415
SPECTRUM OF IONIZED URANIUM	601415
OPTIKA I SPEKTROSKOPIYA 2, 282 (1957)	601415
NSA 15, 18521 (1961)	601415
MORI, T AKETA, D ONO, H SUGITA H	300205
(UNIVERSITY OF KYOTO JAPAN,	300205
EFFECTS OF MO, W, AND CU ON SOLUBILITY OF GRAPHITE IN LIQ IN IRON AND METHOD OF CALCULATION FOR ACTIVITY OF CARBON IN A MULTICOMPONENT SOLUTION	300205
TETSU TO HAGANE 46, 1429 (1960)	300205
CA 55, 19679 (1961)	300205
MORTIMER, C T	301307
REACTION HEATS AND BOND STRENGTHS	301307
READING MASS ADDISON WESLEY PUB CO 1 53 230 (1963)	301307
CA 59, 4598G (1963)	301307
MOTT, N	202104
(UNIV CAMBRIDGE ENGLAND)	202104
COHESIVE FORCES IN METALS AND ALLOYS	202104
REPT. PRGR. PHYS. 25, 218 (1962)	202104
CA58, 9931E (1963)	202104
MOTT, W	700827
RELATIVE VOLATILITIES OF REFRACTORY MATERIALS	700827
TRANS ELECTROCHEM SOC 34, 255 (1918)	700827
MOURET, P RIGAUD, A	201527
(COMM ENERG AT PARIS)	201527
BERYLLIUM	201527
US AT ENERGY COMM CEA 1090, (1958)	201527
CA56, 13907 (1962)	201527
MÖZZI, R GUENTERT, O	300803
X-RAY STUDY OF PHASE TRANSFORMATIONS IN SOME RARE EARTH OXIDE SYSTEMS	300803
J CHEM PHYS 36, 298 (1962)	300803
PA 65, 4356 (1962)	300803
MRKHEEV, V BELOUSOV, O	300280
MELTING DIAGRAM OF THE TI-ZR-NB SYSTEM	300280
ZHUR NEORG KHIM 6, 1905 (1961)	300280

CT 17, 82 (1961)	300280
MUELLER, M HITTERMAN, R KNØTT, H	601431
(ARGONNE NATL LAB LEMONT ILL)	601431
THE ATOMIC POSITION PARAMETER IN ALPHA URANIUM-R00M TEMPERATURE AND ABOVE	601431
ACTA CRYST 15, 421 (1962)	601431
NSA 16, 15206 (1962)	601431
MUELLER, M KNØTT, H	601136
(ARGONNE NATL. LAB LEMONT ILL.)	601136
THE CRYSTAL STRUCTURE OF URANIUM NITRIDE BY NEUTRON DIFFRACTION	601136
ACTA CRYST 11, 751 (1958)	601136
CA 53, 15694 (1959)	601136
MUKAIBO, T NAITO, K SATO, K UCHIJIMA, T	601609
(JAPAN AT EN RES INST TOKYO JAPAN)	601609
THE HEAT OF FORMATION OF U3O7	601609
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS, VIENNA, MAY (1962)	601609
NSA 16, 25378 (1962)	601609
MUKAIBO, T NAITO, K SATO, K UCHIJIMA, T	601610
(JAPAN AT EN RES INST TOKYO JAPAN)	601610
THE MEASUREMENT OF THE SPECIFIC HEAT OF URANIUM CARBIDES ABOVE ROOM TEMPERATURE	601610
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS, VIENNA, MAY (1962)	601610
NSA 16, 25379 (1962)	601610
MULLER, J	200989
(EIDG TECH HOCHSCHULE ZURICH SWITZ)	200989
MEASUREMENT OF SMALL HEAT CAPACITIES IN THE TEMPERATURE REGION 1-100 DEGREES K	200989
HELV PHYS ACTA 33, 514 (1960)	200989
CA 55, 12946 (1961)	200989
MUNSTER, A RINCK, G RUPPERT, W	300320
(LAB METALLGES A G FRANKFURT/MAIN GERMANY)	300320
THE EQUILIBRIUM OF TITANIUM NITRIDE FORMATION AND THE ENTROPY OF TITANIUM TETRACHLORIDE	300320
Z PHYSIK CHEM (NF) FRANKFURT 9, 228 (1956)	300320
CA 51, 2364 (1957)	300320
MURAKAWA, K	601284
(INST OF SCI AND TECH TOKYO JAPAN)	601284
HYPERFINE STRUCTURE OF THE SPECTRA OF ND AND GD	601284
PHYS REV 96, 1543 (1954)	601284
NSA 9, 1686 (1955)	601284
MURAKAWA, K	300826
QUADRUPLE COUPLING IN THE HYPERFINE STRUCTURE OF THE SPECTRUM OF LA I	300826
J PHYS SOC JAPAN 16, 2533 (1961)	300826
PA 65, 3701 (1962)	300826
MURAKAWA, K	600958
(INST SCI TECH TOKYO JAPAN)	600958
HYPERFINE STRUCTURE IN THE SPECTRA OF ANTIMONY, SAMARIUM, MERCURY AND CADMIUM	600958
PHYS REV 93, 1232 (1954)	600958
CA 48, 6821 (1954)	600958

MURAKAWA, K KAMEI, T	601218
HYPERFINE STRUCTURE OF THE SPECTRA OF DYSPROSIUM, COBALT,	601218
VANADIUM, MANGANESE, AND LANTHANUM	601218
PHYS REV 92, 325 (1953)	601218
NSA 8, 654 (1954)	601218
MURAKAWA, K ROSS, J	400556
(UNIV OF WISCONSIN MADISON WISC)	400556
ISOTOPE SHIFT IN THE CERIUM II SPECTRUM AND THE MAGIC NUMBER	400556
EIGHTY-TWO	400556
PHYS REV 83, 1272 (1951)	400556
CA 46, 339 (1952)	400556
MURAKAWA, K SUWA, S	900942
(INST SCI TECH TOKYO JAPAN)	900942
HYPERFINE STRUCTURE IN THE SPECTRA OF IRIDIUM AND OSMIUM	900942
PHYS REV 87, 1048 (1952)	900942
CA 46, 10899 (1952)	900942
NSA 6, 6158 (1952)	900942
MURAT, M EYRAUD, C	201692
THERMAL DECOMPOSITION OF UO ₃ IN A VACUUM. ELECTRICAL	201692
CONDUCTIVITY	201692
COMPT REND 254, 3084 (1962)	201692
CA 57, 4291 (1962)	201692
MURATOV, F NOVSELOVA, A V	301309
(M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	301309
REDUCTION OF BERYLLIUM OXIDE WITH CARBON IN THE PRESENCE OF	301309
NICKEL	301309
ZH NEORGAN KHIM 8, 1084 (1963)	301309
CA 59, 2464E (1963)	301309
MURATOV, F NOVSELOVA, A	300182
A STUDY OF EQUILIBRIUM IN THE REDUCTION OF BERYLLIUM OXIDE	300182
WITH CARBON AT HIGH TEMPERATURE	300182
DOKL AKAD NAUK SSSR 129, 334 (1959)	300182
NP-TR-568	300182
MURATOV, F NOVSELOVA, A	601602
(MOSCOW STATE UNIV MOSCOW RUSSIA)	601602
EQUILIBRIUM IN THE REDUCTION OF BERYLLIUM OXIDE WITH CARBON	601602
DOKLADY AKAD NAUK SSSR 143, 599 (1962)	601602
NSA 16, 19253 (1962)	601602
MURATOV, F NOVSELOVA, A	300771
(LOMONOSOV MOSCOW STATE UNIV MOSCOW RUSSIA)	300771
DETERMINATION OF THE SOLUBILITY OF BERYLLIUM CARBIDE IN	300771
MOLTEN COPPER-BERYLLIUM ALLOY	300771
RUSS J NEORG CHEM 6, NO 8, 1009 (1961)	300771
MURBACH, E TURNER, W	202105
(AT. INTERN. CANOGA PARK CALIF)	202105
OXIDATION OF URANIUM CARBIDE BY CARBON DIOXIDE.	202105
US AT ENERGY COMM NAA-SR-7482, (1962)	202105
CA 58, 8628B (1963)	202105
MURBACH, E	601105
(NORTH AMERICAN AVIATION CO CANOGA PARK CALIF)	601105
AN ESTIMATE OF THE VAPOR PRESSURES OF THORIUM AND PROTACTINIUM	601105
U S ATOMIC ENERGY COMM NAASR-1988 (1957)	601105
CA 52, 4277 (1958)	601105

MURIN, A NEFEDOV, V RYUKHIN, U TOROPOVA, M TECHNETIUM, ELEMENT 43 USPEKHI KHIM 30, 274 (1961)	700574 700574 700574
MURK, K LECTURES IN APPLIED MATHEMATICS VOL 1, PROBABILITY AND RELATED TOPICS IN PHYSICAL SCIENCE INTERSCIENCE PUBLISHERS (1959) NSA 13, 18349 (1959)	601523 601523 601523 601523 601523
MURPHY, A KENNEDY, A (COL OF AERONAUTICS BERKS ENGLAND) TEMPERATURE EFFECTS ON MATERIAL CHARACTERISTICS NP-10063 (1960) NSA 15, 19840 (1961)	701041 701041 701041 701041 701041
MURPHY, R EXTENSION OF THE FIRST SPECTRUM OF RHODIUM J RES NAT BUR STANDARDS 49, 371 (1952) CA 47, 10345 (1953)	600946 600946 600946 600946
MURRAY, J PREPARATION, PROPERTIES, AND ALLOYING BEHAVIOR OF THORIUM ATOMIC ENERGY RESEARCH ESTAB (GT BRIT) M/R 2242, (1958) CA 52, 9908 (1958)	601094 601094 601094 601094
MURTHY, N (KARNATAK UNIV DHARWAR INDIA) ON THE VALIDITY OF THE REVISED ROTATIONAL CONSTANTS OF ALPHA (C TO X) BAND SYSTEM OF ZR0 INDIAN J PHYS 36, 101 (1962) NSA 16, 24303 (1962)	601623 601623 601623 601623 601623 601623
MURTHY, N (KARNATAK UNIV DHARWAR INDIA) INTENSITY ASPECTS AS THE DETERMINANT IN THE BANDS OF THE LA0 (B-X) SYSTEM NATURE 190, 430 (1961) CA 55, 19468 (1961)	301087 301087 301087 301087 301087 301087
MUMPTON, F A ROY, R LOW TEMPERATURE EQUILIBRIA AMONG ZR02, TH02, AND U02 J AM CERAMIC SOC 43, 234 (1960)	301308 301308 301308
MUSCHLITZ, E GOODMAN, L (CORNELL UNIV ITHACA NEW YORK) LIFETIME OF THE STATE OF NITROGENS J CHEM PHYS 21, 2213 (1953) CA 48, 4313 (1954)	600594 600594 600594 600594 600594
MUTHMANN, W WEISS, L METALS OF THE CERIUM GROUP ANN 331, 1 (1904) BA 86, 2, 406 (1904)	800144 800144 800144 800144
MYERS, A (THE UNIVERSITY LEEDS ENGLAND) SOME ELASTIC AND THERMAL PROPERTIES OF ZR AND W PHIL MAG 5, 927 (1960) NSA 15, 1887 (1961)	700981 700981 700981 700981 700981
MYERS, R	500130

(ATOMIC ENERGY RES ESTAB	HARWELL	ENGLAND)	500130
SOME PROPERTIES OF TANTALUM			500130
METALLURGIA 41, 301 (1950)			500130
CA 44, 5776 (1950)			500130
MYKLEBUST, R DAANE, A			201580
(U S AT ENERGY COMM	AMES	IOWA)	201580
THE YTTRIUM MANGANESE SYSTEM			201580
TRANS AIME 224, 354 (1962)			201580
CA 57, 521 (1962)			201580
NACHMAN, J LUNDIN, C			301539
RARE EARTH RESEARCH			301539
GORDON + BREACH, SCIENCE PUBLISHERS, NEW YORK (1962)			301539
NADLER, M KEMPTER, C			300301
(LOS ALAMOS SCIENTIFIC LAB		N MEX)	300301
SOME SOLIDUS TEMPERATURES IN SEVERAL METAL-CARBON SYSTEMS			300301
J PHYS CHEM 64, 1468 (1961)			300301
CA 55, 13026 (1961)			300301
NSA 15, 1877 (1961)			300301
NADOR, B			200938
(RESEARCH INST	VESZPREM	HUNGARY)	200938
PHASE DIAGRAM OF THE SYSTEM VANADIUM PENTOXIDE-BORON TRIOXIDE			200938
NATURE 188, 139 (1960)			200938
CA 55, 10036 (1961)			200938
NAGARJAN, G			202106
MEAN AMPLITUDES OF VIBRATION FOR DIOXIDES OF			202106
ZIRCONIUM, TITANIUM, SILICON AND BORON			202106
INDIAN J. PURE APPL. PHYS. 1 322 (1963)			202106
NAGARAJAN, G			201772
(ANNAMALAI UNIV	ANNAMALAINAGER	S INDIA)	201772
POTENTIAL CONSTANTS AND THERMODYNAMIC PROPERTIES OF SOME			201772
SILYL HALIDES			201772
BULL SOC CHIM BELGES 71, 226 (1962)			201772
CA 57, 7984 (1962)			201772
NAGARAJAN, G			201774
(ANNAMALAI UNIV	ANNAMALAINAGER	S INDIA)	201774
THERMODYNAMIC PROPERTIES OF SOME MIXED HALIDES OF BORON			201774
POTENTIAL CONSTANTS AND THERMODYNAMIC PROPERTIES OF SOME			201774
XY ₄ TYPE MOLECULES IBID 119			201774
BULL SOC CHIM BELGES 71, NO 1, 65 (1962)			201774
CA 57, 7988 (1962)			201774
NAGARAJAN, G			201816
(UNIV ANNAMALAI	ANNAMALAINAGER	S INDIA)	201816
POTENTIAL CONSTANTS AND THERMODYNAMIC PROPERTIES OF			201816
VANADIUM OXYTRICHLORIDE			201816
SCI CULT (CALCUTTA) 28, 140 (1962)			201816
CA 57, 10589 (1962)			201816
NAGASAKI, S TAKAGI, Y			400598
METHODS OF MEASURING SPECIFIC HEAT AT HIGH TEMPERATURES			400598
JOURNAL OF APPLIED PHYSICS OF JAPAN 17, 104 (1948)			400598
NAGASAWA, S			400530
(OSKAKA IND RES INST		JAPAN)	400530
DIELECTRIC PROPERTIES OF OXIDES OF RARE METALS			400530

J ELECTROCHEM SOC JAPAN 18, 158 (1950)	400530
CA 45, 8309 (1951)	400530
NAKATA, M	200855
(NORTH AMERICAN AVIATION CO CANOGA PARK CALIF)	200855
THERMOGRAVIMETRIC BALANCE FOR THE INVESTIGATION OF	200855
HIGH-TEMPERATURE REACTION KINETICS AND THE RESULTS OF	200855
A BERYLLIUM OXIDATION STUDY	200855
US AT ENERGY COMM NAA-4737, (1960)	200855
CA 55, 5060 (1961)	200855
NAKATA, M MCKISSON, R POLLACK, B	300313
(ATOMIC INTERNATIONAL CANOGA PARK CAL)	300313
VAPORIZATION OF ZIRCONIUM OXIDE	300313
US AT ENERGY COMM NAA-SR-6095 (1961)	300313
CA 55, 21710 (1961)	300313
NSA 15, 16048 (1961)	300313
NAMBA, S IMOTA, S SANO, T	400611
THE FORMATION OF UC1-X OX	400611
NIHON GENSHI-RYOKU GAKKAI SHI 6, 457 (1961)	400611
NARBUTT, K LAPUTINA, I	201779
DETERMINATION OF THE OXIDATION STATE OF URANIUM BY MEANS OF	201779
EMISSION X-RAY SPECTRA	201779
Izv Akad Nauk SSSR Ser Fiz 26, 409 (1962)	201779
CA 57, 8069 (1962)	201779
NASADA, K CHERRY, L WALLACE, W	201041
UNIV OF PITTSBURGH PITTSBURGH PA)	201041
INTERMETALLIC COMPOUNDS BETWEEN LANTHANONS AND TRANSITION	201041
METALS OF THE FIRST LONG PERIOD. I. PREPARATION, EXISTENCE AND	201041
STRUCTURAL STUDIES	201041
PHYS AND CHEM SOLIDS 16, 123 (1960)	201041
CA 55, 14246 (1961)	201041
NAZARCHUK, T	201578
CARBON CARBIDE (B4C) CHEMICAL PROPERTIES AND METHODS OF	201578
ANALYSIS	201578
IR SEMINARA DO ZHARZSTRIKIM MATERIALAM AKAD NAUK UKR SSR INST	201578
METALIM KREMNI SPETS SPLAVOV KIEV 1960 6, 20 (1961)	201578
CA 57, 392 (1962)	201578
NAZIMOVA, N	201227
NATURE OF THE ELECTRON OSCILLATION SPECTRUM OF MgO MOLECULES	201227
DOKLADY MEZHVOZ NAUCH KONF DO SPEKTROSKOPII I SPEKTR	201227
ANALIZU, TOMSK UNIV 1960, 48 (1960)	201227
CA 56, 1058 (1962)	201227
NAZIMOVA, N SOROLOV, V	700671
ELECTRONIC-VIBRATIONAL STRUCTURE IN THE OXIDATION SPECTRUM	700671
OF MAGNESIUM	700671
Izvest Vysshikh Ucheb Zavedenii Fiz 143 (1961)	700671
CT No 14, (1961)	700671
NECKEL, A	300509
CALCULATION OF THE FREE ENTHALPY OF MIXING AND THE ACTIVITY	300509
COEFFICIENTS OF SYSTEMS OF LIMITED MISCIBILITY FROM THE	300509
SOLUBILITY CURVE	300509
MONATSH CHEM 92, 468 (1961)	300509
BHT No 3, 34 (1961)	300509
NEEL, D PEARS, C	300146

(SOUTHERN RES INST	BIRMINGHAM	ALABAMA)	300146
THE THERMOPHYSICAL PROPERTIES OF REFRACTORY MATERIALS FROM			300146
2000 DEGREES F TO THEIR DESTRUCTION TEMPERATURE			300146
QUARTERLY REPORT NO 4 FEB 15 TO MAY 15, 1961			300146
NELSON, L KUEBLER, N			301540
(BELL TELEPHONE LABS	MURRAY HILL	NJ)	301540
VAPORIZATION OF TUNGSTEN STUDIED BY FLASH HEATING AND			301540
KINETIC SPECTROSCOPY			301540
J CHEM PHYS 39, NO 4, 1055 (1963)			301540
CA 59, 5941 (1963)			301540
NEMNONOV, S MENSNIKOV, A			200977
K-ABSORPTION SPECTRUM OF CHROMIUM IN BORIDES, CARBIDES,			200977
NITRIDES, AND OTHER COMPOUNDS			200977
TRUDY SEMINARA PO ZHAROSTOIKIM MATERIALAM AKAD NAUK UKR SSR			200977
INST METALLOKERAM I SPETSIAL SPLAVOV KIEV 1958, NO 5, 21 (1960)			200977
CA 55, 12025 (1961)			200977
NESHFOR, V			300792
CRYSTAL STRUCTURES OF THE MONOSILICIDES OF THE TRANSITION			300792
METALS			300792
KRISTALLOGRAFIYA 6, 466 (1961)			300792
PA 65, 6809 (1962)			300792
NESHFOR, V			200896
PHYSICAL PROPERTIES OF METAL-LIKE COMPOUNDS			200896
TRUDY SEMINARA PO ZHAROSTOIKIM MATERIALAM, AKAD NAUK UKR			200896
SSSR INST METALLOKERAM I SPETSIAL SPLAVOV, KIEV 1958,			200896
NO 5, 5 (1960)			200896
CA 55, 6967 (1961)			200896
NESHFOR, V KISLYI, P			700521
HOT PRESSING OF POWDERED CHROMIUM BORIDE AND SOME PROPERTIES			700521
OF THE SINTERED MATERIAL			700521
OGNEUPORY 24, 231 (1959)			700521
CE 44, 616 (1961)			700521
NESHFOR, V SAMSONOV, G			601107
NEW BORIDES OF THE RARE EARTH ELEMENTS			601107
DOPROVIDI AKAD NAUK UKR R S R 478 (1957)			601107
CA 52, 4370 (1958)			601107
NESHFOR, V SAMSONOV, G			601116
(INST METAL ACAD SCI	UKRAINE	USSR)	601116
NEW BORIDES OF RARE EARTH METALS			601116
ZHUR FIZ KHIM 32, 1328 (1958)			601116
CA 53, 953 (1959)			601116
NESHFOR, V SAMSONOV, G			700859
ELECTRON STRUCTURE AND THE CONDITIONS FOR THE FORMATION OF			700859
BORIDES OF THE TYPE MB6			700859
ZHUR NEORG KHIM 4, 1967 (1959)			700859
CA 54, 11605 (1960)			700859
NESHFOR, V SAMSONOV, G			202108
THE ELECTRONIC STRUCTURE OF SILICIDES.			202108
POROSHKOVAYA MET AKAD NAUK UKR SSR 2, NO 6, 14 (1962)			202108
CA 58, 9641H (1963)			202108
NESHFOR, V SAMSONOV, G			301037
ELECTRICAL PROPERTIES MOLYBDENUM SILICIDE			301037
VYSOKOTEMPERATURNYE METALLOKERAM MATERIALY AKAD NAUK UKR			301037

SSR INST METALLØKERAM I SPETS SPLAVØV (1962) 113 CA 58, 5120 (1963)	301037 301037
NESMEYANØV, A VAPØR PRESSURE ØF CHEMICAL ELEMENTS IZD-VØ AKAD NAUK SSSR 395 (1961) RUSS ACC ACT 2044 (1961)	300422 300422 300422 300422
NESMEYANØV, A FIRSØVA, L VAPØR PRESSURE ØF LITHIUM, BERYLLIUM, BØRØN, SILICØN, AND LEAD OXIDES IZVEST AKAD NAUK SSSR ØTDEL TEKH NAUK MET I TØPLIVØ 1959, NØ 3, 150 (1959) CA 55, 13968 (1961)	201019 201019 201019 201019 201019 201019
NESMEYANØV, A FIRSØVA, L (M V LØMØNØSØV STATE UNIV MØSCØW USSR) DETERMINATION ØF VAPØR PRESSURE IN EQUILIBRIUM WITH SØLID SILICØN DIOXIDE ZHUR FIZ KHIM 34, 1907 (1960) CA 55, 11007 (1961)	200953 200953 200953 200953 200953 200953
NESMEYANØV, A FIRSØVA, L MEASUREMENT ØF THE SATURATED VAPØR PRESSURE ØF BØRIC ANHYDRIDE ZHUR FIZ KHIM 34, 1032 (1960) NS 14, 17856 (1960)	600632 600632 600632 600632
NESMEYANØV, A KHANDAMIRØVA, N (UNIV MØSCØW MØSCØW USSR) THE RELATION BETWEEN HEATS ØF SUBLIMATION ØF ELEMENTS AND THEIR POSITIONS IN THE PERIODIC SYSTEM VESTNIK MØSKØV UNIV SER II, 15, NØ 4, 28 (1960) CA 55, 7950 (1961)	600660 600660 600660 600660 600660 600660
NESMEYANØV, A KHANDAMIRØVA, N VILENKII, V BIRIN, E BØRISØV, A (M V LØMØNØSØV STATE UNIV MØSCØW RUSSIA) EFFECT ØF OXIDE FILMS ØN THE RATE ØF EVAPØRATION ZHUR FIZ KHIM 34, 1425 (1960) BHTG NØ 2, 1 (1961)	300955 300955 300955 300955 300955 300955
NESMEYANØV, A PRISEFKØV, YU A VAPØR PRESSURE ØF METALLIC YTTRIUM GERMAN RPT PAPER NØ SM-26/56 PRESENTED AT THE SYMPOSIUM ØN THERMODYNAMICS ØF NUCLEAR MATERIALS VIENNA, MAY 21-25 (1962) AFC-TR-5359 CØTS, P 100, APRIL (1963)	301310 301310 301310 301310 301310 301310
NEUGERAUER, J (HUNG ACAD SCI BUDAPEST HUNGARY) THE INCREASE IN VOLATILITY ØF OXIDES BY WATER VAPØR ACTA CHIM ACAD SCI HUNG 37, 247 (1963) CA 59, 4764G (1963)	301311 301311 301311 301311 301311
NEUMANN, B KRØGER, C HÆBLER, H THE HEATS ØF FØRMATION ØF THE NITRIDES. IV. URANIUM, THØRIUM AND LANTHANUM NITRIDES Z ANØRG CHEM 207, 145 (1932) CA 26, 5823 (1932)	900113 900113 900113 900113 900113
NEUMANN, K VØLKER, E A TØRSIØN METHØD FØR MEASURING VERY LOW VAPØR PRESSURES Z FUER PHYSIK CHEMIE 71, 33 (1932)	900212 900212 900212

NEVITT, M DOWNEY, J	201267
(ARGONNE NATL LAB ARGONNE ILL)	201267
THE ZIRCONIUM RICH CORNERS OF THE TERNARY SYSTEMS	201267
ZR-CO-O AND ZR-NI-O	201267
TRANS AIME 221, 1014 (1961)	201267
CA 56, 2933 (1962)	201267
NEVITT, M DOWNEY, J MORRIS, R	200875
(ARGONNE NATL LAB LEMONT ILL)	200875
Ti2Ni-TYPE PHASES CONTAINING TITANIUM, ZIRCONIUM, OR	200875
HAFNIUM	200875
TRANS AIME 218, 1019 (1960)	200875
CA 55, 5303 (1961)	200875
NEWKIRK, H BATES, J	601165
THE MELTING POINTS OF URANIUM DIOXIDE, URANIUM MONOCARBIDE	601165
AND URANIUM MONONITRIDE	601165
US AT ENERGY COMM HW-59468, (1959)	601165
CA 54, 22127 (1960)	601165
NEWTON, A JOHNSON, O	400559
URANIUM NITRIDE	400559
US PATENT 2544277 (1951)	400559
CA 45, 6358 (1951)	400559
NGHI, N	201687
INTERMEDIATE FLUORIDES OF URANIUM	201687
COMM ENERGIE AT (FRANCE) RAPPT 1976 (1961)	201687
CA57, 4276 (1962)	201687
NICHOLLS, R REEVES, E BRØMLEY, D	600562
EXCITATION OF N2 AND O2 BY ONE HALF MEV PROTONS	600562
PROC PHYS SOC LONDON 74, 87 (1959)	600562
NICHOLS, N HAUSE, C NOBLE, R	600754
(MICHIGAN STATE COLLEGE EAST LANSING MICH)	600754
NEAR INFRARED SPECTRUM OF NITRIC OXIDE	600754
J CHEM PHYS 23, 57 (1955)	600754
CA 49, 5126 (1955)	600754
NICHOLLS, R	300698
FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL QUANTUM NUMBERS II.	300698
SiO, MgO, SrO, AlO, VO, NO	300698
J RES NAT BUR STDS 66A, NO 3, 227 (1962)	300698
NICHOLS, R	601102
URANIUM AND ITS ALLOYS	601102
NUCLEAR ENG 2, 355 (1957)	601102
CA 52, 101 (1958)	601102
NIKIFOROV, I SACHENKO, V	202109
ENERGY BANDS OF TITANIUM IN A CUBIC LATTICE	202109
IZV AN SSSR SER FIZ 27 NO 3, 310 (1963)	202109
NIEDERKORN, I	201771
THERMODYNAMICS OF THE REDUCTION OF TiCl4	201771
REV CHIM (BUCHAREST) 11, 249 (1960)	201771
CA 57, 7983 (1962)	201771
NIEMYSKI, I OLEMPKA, Z	300705
PREPARATION OF PURE BORON FOR SEMICONDUCTOR INVESTIGATIONS	300705

J LESS COMMON METALS 4, NO 3, 235 (1962)	300705
NIGHTINGALE, R	701071
(GENERAL ELECTRIC RICHLAND WASH)	701071
STRUCTURE	701071
NUCLEAR GRAPHITE ACADEMIC PRESS NEW YORK, 1962	701071
NSA 17, 3403 (1963)	701071
NIKITIN, E E	301312
NOTE ON VIBRATION-ROTATION INTERACTION IN THE VIBRATIONAL	301312
RELAXATION OF DIATOMIC MOLECULES	301312
RUSSIAN, KINETIKA I KATALIZ, VOL111, NO 3, 322 (1962)	301312
ENGLISH PAGE 282	301312
COTS 204, APRIL (1963)	301312
NIKITIN, O AKISHIN, P	300954
DETERMINATION OF THE EVAPORATION HEAT OF BORON OXIDE	300954
BY MASS SPECTROMETRY	300954
DOKL AKAD NAUK SSSR 145, NO 6, 1294 (1962)	300954
NIKITIN, O GOROKHOV, L	700692
(MOSCOW STATE UNIV MOSCOW RUSSIA)	700692
COMPOSITION OF BERYLLIUM VAPOR	700692
ZHUR NEORG KHIM 6, 224 (1961)	700692
CCP NO 6, (1961)	700692
NIKITINA, V	200818
SPECTRAL LINES AT 3006.72 AND 3020.00 A	200818
FIZ SBORNIK LVOV UNIV 1958, NO 4, 463 (1958)	200818
CA 55, 2270 (1961)	200818
NIKOLAEV, N IPPOLITOV, E	201575
THE REACTION OF REF6 WITH METAL FLUORIDES	201575
DOKL AKAD NAUK SSSR 140, 129 (1961)	201575
CA57, 379 (1962)	201575
NIKOLAISKI, E	300130
(UNIVERSITY OF FRANKFURT FRANKFURT GERMANY)	300130
ON THE OXIDATION OF TITANIUM CARBIDE	300130
Z PHYSIK CHEM (FRANKFURT) 24, 405 (1960)	300130
BHT, 30 (1960)	300130
NIKOLAYEV, B	400615
THERMODYNAMIC CALCULATION OF ROCKET ENGINES	400615
TERMINODINAMICHESKIY RASCHET RAKETNYKH	400615
DVIGATELEY (1960)	400615
NIKOLSKII, A	301541
(STATE UNIV LENINGRAD POLAND)	301541
EXISTENCE OF TWO MODIFICATIONS OF RUTHENIUM TETROXIDE	301541
ZH NEORGAN KHIM 8, 1289 (1963)	301541
CA 59, 3512 (1963)	301541
NIKONOV, B OTMAKHOVA, N	300254
VAPORIZATION OF THE CHALCOGENIDES OF ALKALINE EARTH METALS	300254
ZHUR FIZ KHIM 35, 1494 (1961)	300254
NILSON, F PETTERSON, O	700819
SUR LA CHALEUR ET LE VOLUME MOLECULAIRE DES TERRE RARES ET DE	700819
LEURS SULFATES	700819
COMPT REND ACAD SCI (PARIS) 91, 232 (1880)	700819
NISELSON, L	201551

MELTING DIAGRAMS OF THE BINARY SYSTEMS FORMED BY ZIRCONIUM AND HAFNIUM HALIDES	201551
ZH NEORGAN KHIM 7, 693 (1962)	201551
CA56, 15123 (1962)	201551
NISHIHARA, M	201493
ZIRCONIUM ALLOYS FOR REACTORS	201493
GENSHIRYOKU KOGYO 6, NO 9, 11 (1960)	201493
CA56, 12624 (1962)	201493
NISHIMURA, H HIRAMATSU, T	201397
RESISTANCE TO CORROSION OF TITANIUM ALLOYS. 1. THE RELATION BETWEEN RESISTANCE TO CORROSION AND THE ELECTRODE POTENTIALS OF TITANIUM ALLOYS	201397
NIPPON KINZOKU GAKKAISHI 21, 465 (1957)	201397
CA 56, 8426 (1962)	201397
NISHIMURA, H KIMURA, H	300169
THE TITANIUM-OXYGEN-CARBON SYSTEM	300169
BULL ENG RES INST KYOTO U 6, 19 (1954)	300169
CA 49, 4949 (1955)	300169
NODDACK, W WALCH, H	601518
SOME PROPERTIES OF THE OXIDES OF THE RARE EARTHS	601518
Z PHYSIK CHEM (LEIPZIG) 11, 194 (1959)	601518
NSA 13, 22771 (1959)	601518
NODDACK, W WALCH, H	601124
(STAATL FORSCHUNGSINST GEØ BAMBERG GERMANY)	601124
THE ELECTRICAL CONDUCTIVITY OF OXIDES	601124
Z ELECTROCHEM 63, 269 (1959)	601124
SEE ALSO AEC-TR-4369	601124
CA 53, 8820 (1959)	601124
NSA 15, 5045 (1961)	601124
NODDACK, W WALCH, H DOBNER, W	601152
(STAATL FORSCH INST GEØCHEM BAMBURG GERMANY)	601152
CONDUCTIVITY MEASUREMENTS ON RARE EARTH METAL OXIDES	601152
Z PHYSIK CHEM (LEIPZIG) 211, 180 (1959)	601152
SEE ALSO AEC-TR-4371	601152
CA 53, 20966 (1959)	601152
NSA 15, 5046 (1961)	601152
NOETH, H HOELLERER, G	301542
COMPOUNDS WITH SILICON-BORON BONDING	301542
ANGEW CHEM 74, NO 18 718 (1962)	301542
NØGA, K	301313
ON THE EVAPORATION FROM OXIDE CATHODES	301313
OYO BUTURI 31, (12) 1041 (1962)	301313
BHT NO 2 (1963)	301313
NØGUCHI, S SATE, T	300227
(TØKYØ METROPOLITAN UNIV TØKYØ JAPAN)	300227
THERMOELECTRIC POWER OF TI AND V CARBIDES	300227
J PHYS SOC JAPAN 15, 2359 (1960)	300227
CA 55, 13987 (1961)	300227
NØLDEKE, G	601028
(UNIV HEIDELBERG GERMANY)	601028
ISOTOPIC DISPLACEMENT IN THE NDII SPECTRUM	601028
Z PHYSIK 143, 274 (1955)	601028
CA 50, 15227 (1956)	601028

NØLDEKE, G STEUDEL, A		600931
(U. ØF HEIDELBERG	HEIDELBERG	600931
ISØTØPE SHIFT IN THE ND11 SPECTRUM	GERMANY)	600931
NATURWISSENSCHAFTEN 41, 332 (1954)		600931
CA 49, 8699 (1955)		600931
NØLDEKE, G STEUDEL, A		600952
(U HEIDELBERG	HEIDELBERG	600952
ISØTØPIC DISPLACEMENT IN THE SPECTRUM ØF NDI	GERMANY)	600952
Z PHYSIK 137, 632 (1954)		600952
CA 48, 11186 (1954)		600952
NØLTING, H SIMMØNS, C KLINGENBERG, J		700841
(G E CØ CINC, XAVIER UNIV CINCINNATI	ØHIØ)	700841
PREPARATION AND PRØPERTIES ØF HIGH PURITY YTTRIUM METAL		700841
J INØRG NUCL CHEM 14, 208 (1960)		700841
NUCL SCI ABSTR 14, 24609 (1960)		700841
NØMURA, S KAWAKUBØ, T YANAGI, T		700638
SPECIFIC HEAT ØF TITANIUM ØXIDE		700638
J PHYS SØC JAPAN 16, 706 (1961)		700638
CT NØ 12, (1961)		700638
NØRIN, R		202110
CRYSTAL STRUCTURE ØF NIØBIUM (12) ØXIDE (29)		202110
(ØRTHØRHØMBIC)		202110
ACTA CHEM SCAND 17, 1391 (1963)		202110
NØRIN, R MAGNELI, A		200781
(UNIV ØF STØCKHØLM	STØCKHØLM	200781
NEW DISCRETE NIØBIUM ØXIDE PHASE	SWEDEN)	200781
NATURWISSENSCHAFTEN 47, 354 (1960)		200781
CA 55, 51 (1961)		200781
NØRMAN, J		200868
(UNIV ØF NEW SØUTH WALES	AUSTRALIA)	200868
CALCIUM PRØDUCTION UNDER HIGH VACUUM		200868
AUSTRALIAN J CHEM ENGRS 1, NØ 2, 9 (1960)		200868
CA 55, 5275 (1961)		200868
NØRMAN, N		300374
METALLIC ØXIDE PHASES ØF NIØBIUM AND TANTALUM		300374
J LESS CØMMØN METALS 4, NØ 1 52 (1962)		300374
AD273216 (1961)		300374
BHT 1, 9 (1962)		300374
NØRMAN, N KØFSTAD, P KRUDTAA, Ø		300527
METALLIC ØXIDE PHASES ØF NIØBIUM AND TANTALUM II		300527
METALLØGRAPHIC STUDIES		300527
J LESS-CØMMØN METALS 4, 124 (1962)		300527
BHT NØ 2, 19 (1962)		300527
NØRRIS, J		601194
WAVE LENGTH TABLE ØF RARE-EARTH ELE MENTS AND ASSØCIATED		601194
ELEMENTS INCLUDING ZIRCØNIUM, THØRIUM, HAFNIUM, RHENIUM		601194
AND TELLURIUM		601194
US AT ENERGY CØMM ØRNL-2774, 739 (1960)		601194
CA 54, 7332 (1960)		601194
NSA 14, 8833 (1960)		601194
NØRTH, J		600984
(ATØMIC ENERGY RES ESTAB	GT BRIT)	600984

A HIGH-TEMPERATURE ADIABATIC CALORIMETER	600984
HEAT OF URANIUM BETWEEN 100 DEG AND 300 DEG C	600984
M/R 1016, (1956)	600984
CA 50, 10506 (1956)	600984
NORTHOTT, L	700582
SOME FEATURES OF THE REFRACTORY METALS	700582
J LESS COMMON METALS 3, 125 (1961)	700582
NORTON, F KINGERY, W	601240
(MIT CAMBRIDGE MASS)	601240
STUDY OF METAL-CERAMIC INTERACTIONS AT ELEVATED TEMPERATURE	601240
TECHNICAL PROGRESS REPORT NYO-3137 (1952)	601240
NSA 6, 1449 (1952)	601240
NORTON, J	701001
(MIT CAMBRIDGE MASS)	701001
FINAL REPORT ON CERAMICS	701001
NP-9664 (1960)	701001
NSA 15, 6385 (1961)	701001
NORTON, J MOWRY, A	300157
SOLUBILITY RELATIONSHIPS OF THE REFRACTORY MONOCARBIDES	300157
JOURNAL OF METALS 1, 133 (1949)	300157
NORTON, J OGILVIE, R	201811
(MASS INST TECH CAMBRIDGE MASS)	201811
PHYSICAL METALLURGY OF UNCOMMON METALS	201811
U S AT ENERGY COMM AECU 4549, (1959)	201811
CA 57, 9539 (1962)	201811
NORTON, J OGILVIE, R KAUFMANN, A	201086
(MASS INST OF TECHNOL CAMBRIDGE MASS)	201086
PHYSICAL METALLURGY OF UNCOMMON METALS	201086
US AT ENERGY COMM AECU 3556 (1957)	201086
CA 55, 17411 (1961)	201086
NØVIKØV, A TYSPIN, M	201632
THE TEMPERATURE COEFFICIENT OF ELECTRIC RESISTIVITY OF MN	201632
ALLOYS	201632
TR INST YADERN FIZ AKAD NAUK KAZ SSR 2, 119 (1959)	201632
CA 57, 3169 (1962)	201632
NØVIKØV, G BAEV, A	300686
SATURATED VAPOR PRESSURE OF TRIVALENT LANTHANUM, CERIUM	300686
PRASEODYMIUM AND NEODYMIUM CHLORIDES	300686
ZH NEORG KHIM 7, 1349 (1962)	300686
NØWØTNY, H	200917
SEVERAL RECENT STUDIES ON REFRACTORY ALLOYS	200917
BULL SOC CHIM FRANCE 1960, 1881 (1960)	200917
CA 55, 7239 (1961)	200917
NØWØTNY, H RUDY, E BENESØVSKY, F	201147
(UNIV VIENNA VIENNA AUSTRIA)	201147
THE SYSTEMS HF-B-C, ZR-B-C	201147
MØNATSH 92, 393 (1961)	201147
CA 55, 20871 (1961)	201147
NØWØTNY, H BENESØVSKY, F BRUKL, C SCHØB, Ø	201170
(UNIV VIENNA VIENNA AUSTRIA)	201170
THE SYSTEMS TI-B-C AND TI-B-N	201170
MØNATSH 92, 403 (1961)	201170

CA 55, 22984 (1961)		201170
NØWØTNY, H AVER-WELSBACH, H		700651
SCANDIUM CARBIDE		700651
MØNATSH CHEM 92, 789 (1961)		700651
CT NØ 16, (1961)		700651
NØWØTNY, H BENESØVSKY, F KIEFFER, R		201339
(UNIV VIENNA VIENNA AUSTRIA)		201339
THE SYSTEMS NB-B AND TA-B		201339
Z METALLKUNDE 50, 417 (1959)		201339
CA 56, 5737 (1962)		201339
NØWØTNY, H BRAUN, H BENESØVSKY, F		201309
SØME BINARY SYSTEMS ØF HAFNIUM		201309
RADEX RUNDSCHAU 1960, 367		201309
CA 56, 4486 (1962)		201309
NØWØTNY, H KIEFFER, R BENESØVSKY, F		601079
PREPARATION ØF URANIUM MØNØCARBIDE AND ITS RELATION TØ THE		601079
CARBIDES ØF REFRACTØRY TRANSITION METALS		601079
REV MET 55, 453 (1958)		601079
CA 52, 19785 (1958)		601079
NØWØTNY, H LAUBE, E		600844
(UNIV VIENNA VIENNA AUSTRIA)		600844
THERMAL EXPANSION ØF HIGH-MELTING PHASES		600844
PLANSEEBER PULVERMET 9, 54 (1961)		600844
CA 55, 19659 (1961)		600844
NØWØTNY, H RUDY, E BENESØVSKY, F		201799
(UNIV VIENNA VIENNA AUSTRIA)		201799
STUDIES ØF THE SYSTEM ZIRCØNIUM-BØRØN-CARBØN AND		201799
ZIRCØNIUM-BØRØN-NITRØGEN		201799
MØNATSH CHEM 91, 963 (1960)		201799
CA 57, 9279 (1962)		201799
NØWØTNY, H BENESØVSKY, F RUDY, E WITTMANN, A		201765
(UNIV VIENNA VIENNA AUSTRIA)		201765
THE STRUCTURE AND CØMBUSTIVE PRØPERTIES ØF NIØBRIUM-BØRØN-		201765
SILICØN ALLØY		201765
MØNATSH CHEM 91, 975 (1960)		201765
CA 57, 6980 (1962)		201765
NYQUIST, Ø LANGE, K CHIPMAN, J		300953
INFLUENCE ØF SILICØN ØN THE ACTIVITY ØF CARBØN IN LIQUID IRØN		300953
TRANS ØF MET SØC ØF AIME 224, 714 (1962)		300953
ØATES, W TØDD, D		201903
(NEWCASTLE UNIV CØLL N S W)		201903
KINETICS ØF THE REDUCTION ØF ØXIDES		201903
J AUSTRALIAN INST METALS 7, 109 (1962)		201903
CA 57, 14470 (1962)		201903
ØBRØWSKI, W		301545
(LAB ØFGUSSA HANAU GERMANY)		301545
ALLØYS ØF RUTHENIUM WITH BØRØN, BERYLLIUM, AND ALUMINUM		301545
METALL 17, 108 (1963)		301545
CA 58, 7669B (1963)		301545
ØBUKHØV-DENISØV, V SIDØRØV, T FAIZULLØV, F CHEREMISINØV, V		200912
VIBRATION SPECTRUM ØF VITREØUS BERYLLIUM FLUØRIDE		200912

ZHUR FIZ KHIM 34, 1622 (1960)	200912
CA 55, 7054 (1961)	200912
ØEISEN, W	600980
THERMODYNAMIC ANALYSIS. III. AUTOMATIC RECORDING OF HEAT	600980
CONTENT CURVES OF METALS AND ALLOYS	600980
ARCH EISENHUTTENW 26, 519 (1955)	600980
CA 49, 15434 (1955)	600980
ØESTHAGER, K ØOFSTAD, P	300957
THE REACTION BETWEEN TANTALUM AND NITROGEN AT 800-1300	300957
DEGREES C	300957
J LESS-COMMON METAL 5, NO 1, 7 (1963)	300957
ØGAWA, M	600755
THE BAND SPECTRUM OF NITRIC OXIDE IN THE NEAR INFRARED REGION	600755
SCI OF LIGHT (TOKYO) 3, NO 1 39 (1954)	600755
PA 58, 1690 (1955)	600755
ØGAWA, M	600757
ON THE EMISSION OF THE BETA-, GAMMA-, AND EPSILON-,	600757
SYSTEMS OF NITRIC OXIDE	600757
SCI OF LIGHT (TOKYO) 3, NO 2 90 (1955)	600757
PA 58, 6891 (1955)	600757
ØGAWA, M	600758
BAND SPECTRA OF NITRIC OXIDE IN THE VISIBLE AND NEAR INFRARED	600758
REGIONS	600758
SCI OF LIGHT (TOKYO) 2, 87 (1953)	600758
PA 57, 10942 (1954)	600758
ØGAWA, M TANAKA, Y	600595
(AIR FORCE CAMB RES CTR BEDFORD MASS)	600595
NEW EMISSION BANDS OF NITROGEN IN THE VACUUM ULTRAVIOLET	600595
REGION	600595
J CHEM PHYS 30, 1354 (1959)	600595
CA 53, 17665 (1959)	600595
ØGAWA, M TANAKA, Y	600596
NEW EMISSION BANDS OF FORBIDDEN SYSTEMS OF NITROGEN IN THE	600596
VACUUM ULTRAVIOLET REGION	600596
J CHEM PHYS 32, 754 (1960)	600596
ØGAWA, K BANDØ, Y	201332
(UNIV KYOTØ JAPAN)	201332
FORMATION OF TIC FROM TI HYDRIDE	201332
FUNTAI ØYØBI FUNMATSUYAKIN 6, 160 (1959)	201332
CA 56, 5617 (1962)	201332
ØGAWA, S	200764
(HØKKAIØ UNIV SAPPØRØ JAPAN)	200764
MAGNETIC TRANSITION IN TICL3	200764
J PHYS SOC JAPAN 15, 1901 (1960)	200764
CA 55, 6981 (1961)	200764
ØGURTSØV, S	200967
METALLØTHERMAL PRØDUCTION OF METALLIC TITANIUM	200967
IZVEST AKAD NAUK SSSR ØTDEL TEKH NAUK MET I TØPLIVØ 1960,	200967
NO 4, 39 (1960)	200967
CA 55, 11223 (1961)	200967
ØLCESE	201602
(UNIV GENØA ITALY)	201602

IT01 SEMIMETALLIC COMPOUNDS OF DYSPROSIUM	201602
ATTI ACCAD NAZI LINCEI REND CLASSE SCI FIS MAT NAT 31, 256	201602
(1961)	201602
CA57, 1831 (1962)	201602
 OLIVER, R C BAIER, R	301314
(AERONUTRONIC NEWPORT BEACH CALIF)	301314
CHEMICAL CORROSION OF ROCKET LINER MATERIALS AND PROPELLANT	301314
PERFORMANCE STUDIES	301314
QUARTERLY TECHNICAL SUMMARY REPT NO 3 15 MARCH (1963)	301314
AD 299130	301314
 OLSEN, C	601336
(LOS ALAMOS SCI LAB LOS ALAMOS N MEXICO)	601336
THE ELECTRICAL RESISTIVITIES OF SM AND EU	601336
BETWEEN 1.4 DEGREES K AND 300 DEGREES K	601336
L A 2406 (1960)	601336
NSA 14, 18234 (U960)	601336
 OLSON, W MULFORD, R	301546
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	301546
THE DECOMPOSITION PRESSURE AND MELTING POINT OF UN	301546
J PHYS CHEM 67, 952 (1963)	301546
CA 58, 13158 (1963)	301546
 ONAKA, R	600716
(MIT CAMBRIDGE MASS)	600716
PERTURBATION AT V=6 OF THE A PRIME PI STATE OF CARBON	600716
MONOXIDE	600716
J CHEM PHYS 25, 1713 (1957)	600716
CA 51, 17437 (1957)	600716
 ONG, J	201536
(FORD MOTOR CO NEWPORT BEACH CALIF)	201536
OXIDATION OF REFRACTORY METALS AS A FUNCTION OF PRESSURE,	201536
TEMPERATURE AND TIME, TUNGSTEN IN OXYGEN	201536
J ELECTROCHEM SOC 109, 284 (1962)	201536
CA56, 14971 (1962)	201536
 ONG, J FASSELL, W	601683
(FORD MOTOR CO DETROIT MICH)	601683
KINETICS OF OXIDATION OF Nb AND OTHER REFRACTORY METALS	601683
CORROSION 18, 382 (1962)	601683
BHT NO 4, (1962)	601683
 ONG, J	201916
(FORD MOTOR CO NEWPORT BEACH CALIF)	201916
OXIDATION OF REFRACTORY METALS AS A FUNCTION OF PRESSURE	201916
TEMPERATURE AND TIME, TANTALUM IN OXYGEN	201916
TRANS AIME 224, 991 (1962)	201916
CA 57, 14855 (1962)	201916
 OPPENHEIM, I HAFEMANN, D	301316
(MASSACHUSETTS INST OF TECH CAMBRIDGE MASS)	301316
THERMODYNAMIC PROPERTIES OF A MONATOMIC HYDROGEN GAS AT HIGH	301316
TEMPERATURES	301316
J CHEM PHYS 39 (1) 101 (1963)	301316
CA 59, 22260 (1963)	301316
 ORANSKAYA, N LEBEDEV, Y PERFILOVA, I	300456
(STATE UNIV LENINGRAD USSR)	300456
THE DISPROPORTIONATION OF VANADIUM TRICHLORIDE	300456
ZHUR NEORG KHIM 6, 259 (1961)	300456

BHTG NO 4, 2 (1962)	300456
ØRBACH, H	301547
(M H D RES INC LOS ANGELES CALIF)	301547
HØW CERAMICS USE PLASMA JET	301547
CERAM INC 79, NO 5, 72 (1962)	301547
CA 58, 4278 (1963)	301547
ØREHØTSKY, J STEINITZ, R	300519
EFFECT ØF ZØNE PURIFICATION ØN THE TRANSITION TEMPERATURE	300519
ØF POLYCRYSTALLINE W	300519
TRANS AIME 224, NO 3, 556 (1962)	300519
BHT NO 2, 11 (1962)	300519
ØREILLY, D	700633
ELECTRONIC CØNFIGURATION ØF METAL ØXIDES	700633
J CHEM EDUC 38, 312 (1961)	700633
CT NO 12, (1961)	700633
ØRIANI, R JØNES, T	600954
(G.E. CØ. SCHENECTADY N.Y.)	600954
APPARATUS FØR THE DETERMINATION ØF THE SØLIDUS TEMPERATURES	600954
ØF HIGH MELTING ALLØYS	600954
REV SCI INSTR 25, 248 (1954)	600954
CA 48, 7939 (1954)	600954
ØRIANI, R MURPHY, W	201864
(U S STEEL CØRP MØNRØEVILLE PA)	201864
THERMØDYNAMICS ØF ØRDERING ALLØYS. IV. HEATS ØF FØRMATION ØF	201864
SØME ALLØYS ØF TRANSITION METALS	201864
ACTA MET 10, NO 9, 879 (1962)	201864
CA 57, 12223 (1962)	201864
ØRMØNT, B	300765
(PHYSICAL-CHEMICAL INST KARPØV RUSSIA)	300765
THE VALENCY ØF ELEMENTS IN CØMPØUNDS AND THE ENERGY ØF	300765
ATOMIZATION ØF SIMPLE SUBSTANCES	300765
ZHUR FIZ KHIM 36, 836 (1962)	300765
ØRMØNT, B F	301317
SØLID PHASES AND CØMPØUNDS ØF VARIABLE CØMPØSITION IN MØDERN	301317
PHYSICAL CHEMISTRY AND CRYSTAL CHEMISTRY	301317
PRØBL FIZ KHIM NO 1 39-155 (1958)	301317
RUSS ACC 15, NO 11 2880 FEBRUARY (1963)	301317
ØRTENBERG, F	300795
THE DEPENDENCE ØF THE ELECTRONIC MØMENT ØF THE	300795
TRANSITION ØN THE INTERNUCLEAR DISTANCE	300795
FØR MØLECULES ØF BAØ, CAØ, MGØ	300795
UKRAINE FIZ ZH 6, 145 (1961)	300795
PA 65, 6192 (1962)	300795
ØRTENBERG, F	900917
DISTRIBUTION ØF INTENSITIES ØF THE ALPHA-SYSTEM BANDS ØF	900917
THE TIO MØLECULE	900917
ØPTIKA SPEK 9, 147 (1960)	900917
PA 64, 3550 (1960)	900917
ØRTENBERG, F	300821
ØN THE RELATIVE VIBRATIONAL TRANSITION PRØBABILITIES IN	300821
THE 2 DELTA-2 DELTA BAND SYSTEM ØF THE VØ MØLECULF	300821
ØPTICA AND SPECTRØSCØPY 11, 417 (1961)	300821

ØRTNER, M ANDERSON, C CAMPBELL, P (VITRO LABS WEST ORANGE NJ) RESEARCH AND DEVELOPMENT ON WASTE STORAGE PROCESS TID-13426 (1959) NSA 15, 30328 (1961)	701066 701066 701066 701066 701066
ØRTØN, G PHASE EQUILIBRIA OF THE W-C SYSTEM DISSERTATION ABST. 22, NO 2, 527 (1961)	300510 300510 300510
ØSBØRNE, D (ARGØNNE NATL LAB LEMONT ILL) THE HEAT CAPACITY AND THERMODYNAMIC FUNCTIONS OF TETRAURANIUM MONOXIDE FROM 5 TO 310 DEGREES K (1956) ANL-5603 NSA 10, 10120 (1956)	601254 601254 601254 601254 601254 601254
ØSBØRNE, D STEIN, L (ARGØNNE NATL LAB ARGØNNE ILL) THERMOCHEMISTRY AND THERMODYNAMIC PROPERTIES OF SUBSTANCES ANN REV PHYS CHEM 13, 127 (1962) CA 57, 15889 (1962)	201923 201923 201923 201923 201923
ØSBØRNE, D WESTRUM, E (ARGØNNE NATL LAB LEMONT ILL) THE HEAT CAPACITIES OF THORIUM DIOXIDE FROM 10 DEGREES TO 305 DEGREES K, THE HEAT CAPACITY ANOMALIES IN URANIUM DIOXIDE AND NEPTUNIUM DIOXIDE J CHEM PHYS 21, 1884 (1953) CA 48, 1130 (1954)	600968 600968 600968 600968 600968 600968
ØSMININ, Y THERMOPHYSICAL PROPERTIES OF MOLTEN METALS BELØRUSSIAN PER INZHENERNØ-FIZ ZHUR AK NAUK BELØRUSSKØY SSR VØL V NO 2 108, (1962) ACE-TR-5454 CØTS 63, (1963)	301152 301152 301152 301152 301152 301152
ØSTBERG, G (AB ATØMENERGI STØCKHØLM SWEDEN) THE METALLURGY AND METALLOGRAPHY OF ZIRCØNIUM TEK TIDSKR 91, 1039 (1961) CA 56, 7005 (1962)	201364 201364 201364 201364 201364
ØSTHAGEN, K KØFSTAD, P (CENTRAL INST IND RES ØSLØ NØRWAY) THE REACTION BETWEEN TANTALUM AND NITRØGEN AT 800-1300 DEGREES J LESS-CØMMØN METALS 5, NO 1, 7 (1963) CA 58, 12250 (1963)	301548 301548 301548 301548 301548 301548
ØVCHARENKØ, I TUNITSKII, L YAKUTIN, V BAND ANALYSIS OF THE SIC MOLECULE ØPTIKA I SPEKTRØSKØPIYA 8, 746 (1960) CA 55, 13045 (1961)	600778 600778 600778 600778
ØVCHARENKØ, Ø TO DETERMINE THE ENERGY OF FØRMATION OF VACANCIES IN SILVER UKRAIN FIZ ZHUR 6, NO 1, 139 (1961) FTD-TT-63-124	900229 900229 900229 900229
ØVERTØN, W HANCØCK, J TABLES OF EINSTEIN ENERGY, SPECIFIC HEAT, AND DERIVATIVE	300244 300244

SPECIFIC HEAT FUNCTIONS	300244
NRL REPORT 5502 (1960)	300244
US GOVT PUB 1397 PB 146403	300244
 ØZERØV, R	 701064
CRYSTAL CHEMISTRY OF THE OXYGEN COMPOUNDS OF VANADIUM,	701064
TUNGSTEN AND MOLYBDENUM	701064
USPEKHI KHIM 24, 951 (1955)	701064
AEC-TR-4839	701064
NSA 15, 32079 (1961)	701064
 ØZIMØV, B	 700591
REFLECTION SPECTRA OF CERTAIN INORGANIC COMPOUNDS IN ORGANIC	700591
LIQUID MEDIUM	700591
IZVEST VYSSHIK UCHEB ZAVEDENII KHIM I KHIM TEKHNOLOG 4, 28	700591
(1961)	700591
 PADERNØ, V	 202112
CERTAIN PHYSICAL PROPERTIES OF SPECIMENS OF HAFNIUM CARBIDE	202112
CERAMIC METAL	202112
IZV AN SSR OTD TEKH NAUK MET I TOP NO 6, 176 (1962)	202112
RUSS ACC 16, NO 1, 149 (1963)	202112
 PADERNØ, Y	 201276
SYNTHESIS OF URANIUM DODECABORIDE	201276
AT ENERGY (USSR) 10, 396 (1961)	201276
CA 56, 3101 (1962)	201276
 PADERNØ, Y FØMENKØ, V SAMSONØV, G	 200933
NEODYMIUM HEXABORIDE	200933
UKRAIN KHIM ZHUR 26, 409 (1960)	200933
CA 55, 9136 (1961)	200933
 PADERNØ, Y SAMSONØV, G	 300134
ON THE PROBLEM OF THE BORIDES OF THE RARE EARTH METAL,	300134
ZHUR NEORG KHIM 5, 1914 (1960)	300134
BHT, 7 (1960)	300134
 PADERNØ, Y SAMSONØV, G	 700587
ELECTRICAL PROPERTIES OF THE HEXABORIDES OF ALKALINE EARTH AND	700587
RARE EARTH METALS AND THORIUM	700587
DOKLADY AKAD NAUK SSSR 137, 646 (1961)	700587
NSA 15, 18542 (1961)	700587
 PADERNØ, Y SAMSONØV, G FØMENKØ, V	 200971
ELECTRICAL PROPERTIES OF LANTHANUM BORIDE	200971
FIZ METAL I METALLOVED AKAD NAUK SSSR 10, 633 (1960)	200971
CA 55, 11979 (1961)	200971
 PADERNØ, Y SEREBRYAKØVA, T SAMSONØV, G	 700534
PREPARATION AND SOME PROPERTIES OF HAFNIUM BORIDE	700534
TSVETNYYE METALLY (USSR) 11, 48 (1959)	700534
TT 5, 318 (1961)	700534
 PAINE, R CARRABINE, J	 201197
SOME NEW INTERMETALLIC COMPOUNDS OF BE	201197
ACTA CRYST 13, 680 (1960)	201197
CA 56, 84 (1962)	201197
 PAINE, R STØNEHOUSE, A BEAVER, W	 201391
(BRUSH BERYLLIUM CO CLEVELAND OHIO)	201391
INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS	201391

US DEPT COMM OFFICE TECH SERV PB REPT 161,683, (1960) CA 56, 8406 (1962)	201391 201391
PAINE, R STONEHOUSE, A BEAVER, W (BRUSH BERYLLIUM CO CLEVELAND OHIO) INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS US DEPT COM OFFICE TECH SERV PB REPT 171,081 (1960) CA 57, 3167 (1962)	201631 201631 201631 201631 201631
PAK, T KOGAN, V TREATMENT OF EQUILIBRIUM IN TERNARY SYSTEMS BY REDUCTION TO BINARY SYSTEMS RUSS J PHYS CHEM 36, 877 (1962)	202113 202113 202113 202113
PALENIK, C WARF, J HYDROLYSIS OF LANTHANUM AND CERIUM CARBIDES INORG CHEM 1, 345 (1962)	700850 700850 700850
PALENIK, G (UNIV OF S CALIF LOS ANGELES CALIF) RARE EARTH CARBIDES-STRUCTURAL AND HYDROLYTIC STUDIES UNIV MICROFILMS (ANN ARBOR, MICH), L C CARD NO MIC 60-6215, DISSERTATION ABSTR 21, 1367 (1960) CA 55, 7125 (1961)	200914 200914 200914 200914 200914 200914
PALGUEV, S NECEIMIN, A (INST ELECTROCHEM SVERDLØVSK USSR) THE NATURE OF ELECTRICAL CONDUCTIVITY OF BE,MG,CA, AND SR OXIDES AT HIGH TEMPERATURES FIZ TVERD TELA 4, 855 (1962) CA57, 5412 (1962)	201717 201717 201717 201717 201717 201717
PALGUEV, S VØLCHENKØVA, Z (INST ELECTROCHEM SVERDLØVSK RUSSIA) CONDUCTIVITY AND TRANSFERENCE NUMBERS FOR THE CERIUM OXIDE- ZIRCONIUM OXIDE SYSTEM ZHUR FIZ KHIM 34, 452 (1960) CA 55, 17143 (1961)	201074 201074 201074 201074 201074 201074
PALIK, E RAO, K (OHIO STATE UNIV COLUMBUS OHIO) PURE ROTATIONAL SPECTRA OF CARBON MONOXIDE, NITRIC OXIDE AND NITROUS OXIDE BETWEEN 100 AND 600 MICRONS J CHEM PHYS 25, 1174 (1956) CA 51, 5553 (1957)	600717 600717 600717 600717 600717 600717
PALMER, P MC MASTERS, Ø LARSEN, W (IOWA STATE UNIV AMES IOWA) THORIUM-VANADIUM PHASE DIAGRAM AM SOC METALS TRANS QUART 55, 301 (1962) CA 57, 8307 (1962)	201791 201791 201791 201791 201791
PAN, V DEFINITION OF EQUILIBRIUM DIAGRAMS FOR CR-NB AND NbCr2-Ni3Nb SYSTEMS DØPØVIDI AKAD NAUK UKR 332 (1961) CA57, 4091 (1962)	201635 201635 201635 201635 201635
PANISH, M (AVCØ/RAD WILMINGTON MASS) VAPORIZATION OF SEVERAL RARE EARTH OXIDES J CHEM PHYS 34, 1079 (1961) NSA 15, 12934 (1961)	601372 601372 601372 601372 601372

PANISH, M			601409
(AVCØ/RAD	WILMINGTON	MASS)	601409
VAPØRIZATION ØF THE RARE EARTH ØXIDES			601409
J CHEM PHYS 34, 2197 (1961)			601409
NSA 15, 22293 (1961)			601409
PANISH, M REIF, L			300721
(AVCØ/RAD	WILMINGTON	MASS)	300721
VAPØRIZATION ØF RUTHENIUM AND ØSMIUM			300721
J CHEM PHYS 37, 128 (1962)			300721
PANISH, M REIF, L			700639
(AVCØ/RAD	WILMINGTON	MASS)	700639
VAPØRIZATION ØF IRIDIUM AND RHØDIUM			700639
J CHEM PHYS 34, 1915 (1961)			700639
PANISH, M REIF, L			300959
(AVCØ RAD	WILMINGTON	MASS)	300959
THERMØDYNAMICS ØF THE VAPØRIZATION ØF HF AND HFØ2			300959
DISSØCIATION ENERGY ØF HFØ			300959
J CHEM PHYS 38, 253 (1963)			300959
PANKRATZ, L KELLEY, K			301549
(US BUR ØF MINES	BERKELEY	CALIF)	301549
HIGH-TEMPERATURE HEAT CØNTENTS AND ENTROPY ØF SESQUIØXIDES			301549
ØF LUTETIUM, DYSPRØSIUM, AND CERIUM			301549
US BUR MINES REPT INVES NØ 6248, 8 (1963)			301549
CA 59, 5860 (1963)			301549
PANKRATZ, L B KELLEY, K K			301319
(US BUR ØF MINES	BERKELEY	CALIF)	301319
HIGH-TEMPERATURE HEAT-CØNTENT AND ENTROPY DATA FØR VANADIUM			301319
SILICIDE			301319
US BUR MINES REPT INVEST NØ 6241, 5 (1963)			301319
CA 59, 4597D (1963)			301319
PANKRATZ, L KING, E			202114
(US BUR ØF MINES	BERKELEY	CALIF)	202114
HIGH-TEMPERATURE HEAT CØNTENTS AND ENTROPY ØF THE			202114
SESQUIØXIDES ØF ERBIUM, HØLMIUM, THULIUM, AND YTTERBIUM.			202114
US BUR MINES REPT INVEST NØ 6175, (1963)			202114
CA 58, 968H (1963)			202114
PANKRATZ, L KING, E KELLEY, K			300958
HIGH TEMPERATURE HEAT CØNTENTS AND ENTROPY ØF SESQUIØXIDES			300958
ØF EURØPIUM, GADØLINIUM, NEØDYMIUM, SAMARIUM AND YTTRIUM			300958
US BUR MINES REPT 6033 (1962)			300958
CA 56, 15896 (1962)			300958
PANNETIER, G MARSIGNY, L DESCHAMPS, P			600851
ETUDE SPECTRØSCØPIQUE DE LA REACTION DES HYDRØCARBURES			600851
CHLØRES AVEC DES ATØMES LIBRES DAZØTE ØBSERVATION DE NØUVELLE			600851
BANDES DE QUEUE DU SYSTEME VIOLET, DE CN			600851
J CHIM PHYS 58, 857 (1961)			600851
PANNETIER, G MARSIGNY, L GUENEBAUT, H			600850
ØBSERVATION DE LA TRANSITION DE LA MØLECULE N2 DANS LA			600850
REACTION DE QUELQUES CØMPØSE ØRGANIQUE AVEC DES ATØMES			600850
LIBRES DAZATE ATTRIBUTION DUNE NØUVELLE BAND IDENTIFEE AU			600850
NIVFAU 5,5 DE CETTE TRANSITION			600850
J CHIM PHYS 58, 725 (1961)			600850

PAPOUSEK, D CERMAN, O TRAVNICKOVA, G KUCIREK, J	301550
THERMODYNAMIC FUNCTIONS OF AN ANHARMONIC OSCILLATOR AND A	301550
VIBRATING ROTATOR	301550
SPIŠY PRÍRODOVEDECKE FAK UNIV BRNE NO 429, 19 (1962)	301550
CA 58, 8461 (1963)	301550
PAPOUSEK, D	700675
ROTATIONAL PARTITION FUNCTIONS OF DIATOMIC MOLECULES IN 3PI	700675
ELECTRONIC STATES	700675
TRANS FARADAY SOC 57, 884 (1961)	700675
PARK, J WYMAN, L	201092
(NATL BUR OF STANDARDS WASHINGTON D C)	201092
PHASE RELATIONS IN MAGNESIUM ALLOYS	201092
US AT ENERGY COMM WADC TR 57-504 (1957)	201092
CA 55, 17439 (1961)	201092
PARKINSON, W REEVES, E	202115
(HARVARD COLL. OBS. CAMBRIDGE MASS)	202115
THE SPECTRUM TITANIUM NITRIDE	202115
CAN J PHYS 41 (4) 702 (1963)	202115
CA 58, 2297 (1963)	202115
PARKINSON, D ROBERTS, L	601151
(RADAR RES ESTAB. MALVERN ENGLAND)	601151
THE ATOMIC HEAT OF CERIUM BETWEEN 1.5 AND 20 DEG K	601151
PROC PHYS SOC 70, 471 (1957)	601151
CA 53, 19552 (1959)	601151
PARKINSON, D SIMON, F SPEDDING, F	400557
(OXFORD UNIV OXFORD ENGLAND)	400557
THE ATOMIC HEATS OF THE RARE EARTH ELEMENTS	400557
PROC ROY SOC LONDON A207, 137 (1951)	400557
CA 46, 303 (1952)	400557
PARKINSON, W NICHOLLS, R	600612
SHOCK TUBE SPECTROSCOPY. I. THE SHOCK EXCITATION OF POWDERED	600612
SOLIDS	600612
AFCRC-TN-59-620 (1959)	600612
AD-228877	600612
PARKS, B BURTON, D	200884
THERMODYNAMIC PROPERTIES OF GASEOUS URANIUM HEXAFLUORIDE	200884
US AT ENERGY COMM K-1458, (1960)	200884
CA 55, 6126 (1961)	200884
PARTHE, E NORTON, J	201404
(MIT CAMBRIDGE MASS)	201404
THE TERNARY SYSTEM ZIRCONIUM, SILICON, BORON	201404
MONATSH 91, 1127 (1960)	201404
CA 56, 9471 (1962)	201404
PARTHE, E SADAGOPAN, V	300520
STUDIES ON TUNGSTEN CARBIDE WC BY MEANS OF NEUTRON	300520
AND X-RAY DIFFRACTION COMPARED WITH PREVIOUS ELECTRON	300520
DIFFRACTION DATA	300520
MONATSH CHEM 93, 263 (1962)	300520
RHT NO 2, 11 (1962)	300520
PARTHE, E SADAGOPAN, V	601630
(PENN STATE UNIV PHILADELPHIA PENNA)	601630
(MIT CAMBRIDGE MASS)	601630
THE STRUCTURE OF DIMOLYBDENUM CARBIDE BY NEUTRON DIFFRACTION	601630

TECHNIQUE	601630
NP-11699	601630
NSA 16, 19364 (1962)	601630
PASCAL, P	601453
(PARIS, MASSON ET CIE PARIS FRANCE)	601453
NOUVEAU TRAITE DE CHIMIE MINERALE	601453
TOME XV. URANIUM ET TRANSURANIENS	601453
PREMIER FASCICULE URANIUM	601453
NSA 16, 199 (1962)	601453
PASCAL, P	601452
(PARIS, MASSON ET CIE PARIS FRANCE)	601452
NOUVEAU TRAITE DE CHIMIE MINERALE IRIDIUM	601452
TOME XIX. RUTHENIUM-OSMIUM-RHODIUM-IRIDIUM-PALLADIUM-	601452
PLATINE	601452
NSA 16, 200 (1962)	601452
PAULE, R	601479
(UNIV WISCONSIN MADISON WISCONSIN)	601479
STUDIES AT HIGH TEMPERATURES I. THEORETICAL ANALYSIS OF	601479
KNUDSEN AND LANGMUIR TECHNIQUES FOR VAPOR PRESSURE	601479
MEASUREMENTS. II VAPOR PRESSURES OF IR, RU, AND B	601479
DISSERTATION ABSTR 22, 4200 (1961)	601479
BHT NO 3, 24 (1962)	601479
PAULE, R C MARGRAVE, J L	301320
A LANGMUIR DETERMINATION OF THE SUBLIMATION PRESSURE OF BORON	301320
J PHYS CHEM 67, 1368 (1963)	301320
J ELECTROCHEM SOC 102, 399 (1963)	301320
PCHELKIN, I	300649
SPECIFIC HEAT OF MOLTEN METALS	300649
VOPROSY TEPLOBMEHA AKAD NAUK SSSR,	300649
ENERGET INST IM GM KRZHIZHANOVSKOGO 1959, 46 (1959)	300649
CA 55, 24211 (1961)	300649
PEAKALL, K ANTILL, J	601682
(AERE HARWELL ENGLAND)	601682
OXIDATION OF URANIUM MONOCARBIDE	601682
J LESS COMMON METALS 4, 426 (1962)	601682
BHT NO 4, (1962)	601682
PEARLMAN, N KEESOM, P	300171
THE ATOMIC HEAT OF SILICON BELOW 100 DEGREES K	300171
PHYS REV 88, 398 (1952)	300171
PEARSON, W	301029
(NATL RES COUNCIL OTTAWA CANADA)	301029
COMMENTS ON EVIDENCE OF METALLIC BONDING IN TIN	301029
ACTA MET 10, 1123 (1962)	301029
CA 58, 5247 (1963)	301029
PECKNER, D	201944
REFRACTORY METALS ROUNDUP	201944
MATER DESIGN ENG 55, NO 4, 131 (1962)	201944
CA 57, 16265 (1962)	201944
PECKNER, D	201307
NIOBIUM	201307
MATERIALS IN DESIGN ENG 54, NO 7, 107 (1961)	201307
CA 56, 4482 (1962)	201307

PEMSLER, J	700650
(NUCLEAR METALS, INC CONCORD	700650
THERMODYNAMICS OF THE INTERACTION OF NIOBIUM AND TANTALUM WITH	700650
OXYGEN AND NITROGEN AT TEMPERATURES NEAR THE MELTING POINT	700650
J ELECTROCHEM SOC 108, 744 (1961)	700650
CT NO 16, (1961)	700650
NSA 15, 26028 (1961)	700650
PENG, R CHOU, Y	300269
SOLUBILITY OF TITANIUM AND CARBON IN THE FE-TI-C SYSTEM	300269
KO HSNEH TUNG PAO 499, (1958)	300269
CA 53, 8988E (1959)	300269
PENNER, S	202117
(GORDON AND BREACH NEW YORK NY)	202117
CHEMICAL ROCKET PROPULSION AND COMBUSTION RESEARCH	202117
CA 58, 5447 (1963)	202117
PENKIN, N SHABANOVA, L	601601
OSCILLATOR STRENGTHS OF SPECTRAL LINES OF MAGNESIUM, STRONTIUM,	601601
AND BARIUM	601601
OPTICS AND SPECTROSCOPY (USSR) 12, 1 (1962)	601601
NSA 16, 18224 (1962)	601601
PEREZ Y JORBA, M	301491
(CENTRE ETUDES CHIM VITRY-SUR-SEINE FRANCE)	301491
ZIRCONIA-RARE EARTH OXIDES SYSTEM	301491
ANN CHIM 7, 479 (1962)	301491
CA 58, 13577 (1963)	301491
PERFILOVA, I ET AL	201221
ENTHALPY OF FORMATION OF VANADIUM OXYCHLORIDE	201221
VESTNIK LENINGRAD UNIV 16, NO 16, SER FIZ I KHIM NO 3,	201221
130 (1961)	201221
CA 56, 1010 (1962)	201221
PERIO, P	600967
CRYSTALLINE VARIETIES OF UO ₃	600967
BULL SOC CHIM FRANCE 776 (1953)	600967
CA 48, 1102 (1954)	600967
PERIO, P	601283
CONSIDERATIONS OF THE URANIUM OXIDES BETWEEN UO ₂ AND U ₃ O ₈	601283
BULL SOC CHIM FRANCE 840 (1953)	601283
AEC-TR-2061	601283
NSA 9, 1794 (1955)	601283
PERIO, P	601033
CRYSTALLOGRAPHIC STUDY OF THE URANIUM-OXYGEN SYSTEM	601033
COMM ENERGIE ATOMIQUE RAPP 363, 107 (1955)	601033
CA 51, 35 (1957)	601033
NSA 10, 8328 (1956)	601033
PERIO, P	601216
CONSIDERATION OF THE URANIUM OXIDE, BETWEEN UO ₂ AND U ₃ O ₈	601216
BULL SOC CHIM FRANCE 9, 840 (1953)	601216
NSA 7, 6436 (1953)	601216
PERKINS, R CROOKS, D	201090
(LOCKHEED PALO ALTO CALIF)	201090
LOW-PRESSURE, HIGH TEMPERATURE OXIDATION OF TUNGSTEN	201090
J METALS 13, 490 (1961)	201090
CA 55, 17420 (1961)	201090

PESIC, D	701002
(INST OF NUCLEAR SCI BELGRADE YUGOSLAVIA)	701002
ISOTOPE EFFECT IN BAND SPECTRA OF MAGNESIUM OXIDE	701002
PROC PHYS SOC (LONDON) 76, 844 (1960)	701002
NSA 15, 7347 (1961)	701002
CA 55, 8035 (1961)	701002
PETER, A	201523
PREPARATION OF TITANIUM DIOXIDE	201523
CHEM TECH (BERLIN) 14, 103 (1962)	201523
CA56, 13747 (1962)	201523
PETERSON, D	201246
(IOWA STATE UNIV AMES IOWA)	201246
THERMODYNAMICS AND KINETICS OF DEOXIDATION OF THORIUM BY CA	201246
TRANS AIME 221, 924 (1961)	201246
CA 56, 2043 (1962)	201246
PETIT, G DELBOVE, F	300785
DETERMINATION OF THE HEAT AND ENTROPY OF FUSION OF	300785
ALKALINE-EARTH FLUORIDES BY THE CRYOMETRIC METHOD AT	300785
HIGH TEMPERATURE	300785
C R ACAD SCI (FRANCE) 254, NO 8, 1388 (1962)	300785
PA 65, 9463 (1962)	300785
PETTERSON, A LINDGREN, B	301162
(UNIV STOCKHOLM STOCKHOLM SWEDEN)	301162
THE B PI-D-SIGMA TRANSITION OF TiO	301162
ARKIV FYSIK 22, 491 (1962)	301162
BHT NO 7, 14 (1963)	301162
PETTERSSON, A LINDGEN, B	700544
TITANIUM MONOXIDE BAND AT 10025A	700544
NATURWISS 48, 128 (1961)	700544
PHILIPP, W	300521
EVIDENCE OF METALLIC BONDING OF TIN	300521
ACTA MET 10, NO 5, 584 (1962)	300521
BHT NO 2, 11 (1962)	300521
PHILLIPS, J	300165
(UNIVERSITY OF CALIFORNIA BERKELEY CALIFORNIA)	300165
THE LABORATORY DETERMINATION OF RELATIVE TRANSITION	300165
PROBABILITIES OF DIATOMIC MOLECULES I. THE ALPHA-SYSTEM	300165
OF TiO	300165
ASTROPHYS J 119, 274 (1954)	300165
CA 48, 5644 (1954)	300165
PHILLIPS, J	600891
A ROTATIONAL ANALYSIS OF THE GAMMA-SYSTEM OF THE TiO MOLECULE	600891
BERKELEY ASTRONOMICAL DEPT UNIV OF CALIF	600891
ASTROPHYS J 114, 152 (1951)	600891
PHILLIPS, J	600890
SINGLET ELECTRONIC STATES OF THE TiO MOLECULE	600890
ASTROPHYS J 111, 314 (1950)	600890
PHILLIPS, T WHITE, D JOHNSTON, H	600892
KINETICS, THERMODYNAMICS, PHYSICAL, CHEMICAL PROPERTIES	600892
AND MANUFACTURE OF AMMONIA	600892
AD-8216 (1952)	600892

PICKETT, J. LEVINE, E. NOWAK, W. (NUCLEAR METALS INC. CONCORD MASS) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY STABILITY OF THE HIGH TEMPERATURE BETA PHASE IN BERYLLIUM AND BERYLLIUM ALLOYS NMI-1252 NSA 16, 2180 (1962)	601587 601587 601587 601587 601587 601587 601587
PICON, M. DOMANGE, L. FLAHAUT, J. GUITTARD, M. PATRIE, M. THE SULFIDES M_2S_3 AND M_3S_4 OF THE RARE EARTH ELEMENTS BULL SOC CHIM FRANCE 2, 221 (1960) CA 55, 196 (1961)	200790 200790 200790 200790
PIJANOWSKI, S. DELUCAS, L. (KAPL SCHENECTADY NEW YORK) MELTING POINTS IN THE SYSTEM $PuO_2 - UO_2$ U S AT ENERGY COMM KAPL 1937, 1 (1960) CA 55, 11973 (1961)	600767 600767 600767 600767 600767 600767
PILCHER, G. SKINNER, H. (UNIV MANCHESTER ENGLAND) VALENCE-STATE OF BORON, CARBON, NITROGEN, AND OXYGEN J INORG NUCL CHEM 24, 937 (1962) CA 58, 5050 (1963)	301044 301044 301044 301044 301044
PILQYAN, G. EVSEEV, A. GERASIMOV, Y. (M V LOMONOSOV STATE UNIV MOSCOW USSR) THERMODYNAMIC PROPERTIES OF CHROMIUM-TANTALUM ALLOYS ZHUR FIZ KHIM 34, 1768 (1960) CA 55, 10037 (1961)	300178 300178 300178 300178 300178
PINAEV, G. CONSTRUCTION OF PHASE DIAGRAMS OF MUTUAL SYSTEMS WITH USE OF WEIGHT PERCENTAGES ZH NEORG KHIM 8, 751 (1963) CA 59, 1139 (1963)	202118 202118 202118 202118 202118
PIPPIG, E. (PHYS TECH ZENTRALINST BERLIN) PRESSURE AND TEMPERATURE COEFFICIENTS OF THE ELECTRICAL RESISTANCE OF RHENIUM ALLOYS ANN PHYSIK 8, 318 (1961) CA57, 1671 (1962)	201599 201599 201599 201599 201599 201599
PIROGOV, A. LIGHT WEIGHT FOAM REFRACTORIES MADE FROM ZrO_2 FOR HIGH TEMPERATURE THERMAL INSULATION OGNEUPORY 27, 275 (1962)	300625 300625 300625 300625
PISTORIUS, C. (UNIV OF CALIF LOS ANGELES CALIF) INFRARED SPECTRUM OF $Th(OH)_4$ J INORG + NUCLEAR CHEM 15, 187 (1960) CA 55, 5124 (1961)	200864 200864 200864 200864 200864
PLANTF, E. STRUCTURES AND PHASE RELATIONSHIPS IN THE MOLYBDENUM-OXYGEN SYSTEM AND THE HIGH TEMPERATURE VAPORIZATION BEHAVIOR OF MOLYBDENUM DIOXIDE DISSERTATION ABST 21, NO 5 1081 (1960) BHT, (1960)	300141 300141 300141 300141 300141 300141

PLOETZ, G KRYSTYNIAK, C DUMES, H (KNOLLS AT POWER LAB SCHENECTADY THERMAL EXPANSION OF FOUR RARE EARTH OXIDES KAPL-M-GLP-1 (1957) NSA 11, 7964 (1957)	600718 600718 600718 600718 600718
PLYLER, E ALLEN, H TIDWELL, E EMISSION SPECTRUM OF CARBON MONOXIDE FROM 2.1 TO 6.5 MICRONS J RES NATL BUR STANDS 61, 53 (1958) PA 62, 2202 (1959)	600718 600718 600718 600718
PLYLER, E BENEDICT, W SILVERMAN, S PRECISE MEASUREMENTS IN THE INFRARED SPECTRUM OF CARBON MONOXIDE J CHEM PHYS 20, 175 (1952) CA 46, 6487 (1952)	600719 600719 600719 600719 600719
PLYLER, E BLAINE, L CONNOR, W (NATL BUREAU OF STDS WASHINGTON D C) VELOCITY OF LIGHT FROM THE MOLECULAR CONSTANTS OF CARBON MONOXIDE J OPT SOC AMER 45, 102 (1955) CA 49, 5123 (1955)	600720 600720 600720 600720 600720 600720
PLYLER, E BLAINE, L TIDWELL, E (NATL BUREAU OF STDS WASHINGTON D C) INFRARED ABSORPTION AND EMISSION SPECTRA OF CARBON MONOXIDE IN THE REGION FROM 4 TO 6 MICRONS J RESEARCH NATL BUR STANDS 55, 183 (1955) CA 50, 16385 (1956)	600721 600721 600721 600721 600721 600721
POCH, W DIETZEL, A (MAX-PLANCK-INST WUERZBURG GERMANY) THE FORMATION OF SILICON CARBIDE FROM SILICON DIOXIDE AND CARBON BER DEUT KERAM GES 39, 413 (1962) CA 58, 9855 (1963)	202119 202119 202119 202119 202119 202119
POE, A (NORTHWESTERN UNIV EVANSTON ILL) A SIMPLE COMPUTATION OF EQUILIBRIUM CONSTANTS J PHYS CHEM 67, 1070 (1963) CA 58, 13197 (1963)	301551 301551 301551 301551 301551
POLAND, D GREEN, J MARGRAVE, J IDEAL GAS THERMODYNAMIC FUNCTIONS OF SOME SELECTED ELEMENTS J CHEM ENG DATA 7, NO 3, 389 (1962) CT NO 16, 94 (1962)	300758 300758 300758 300758
POLKOVNIKOV, B BALANDIN, A TABER, A CATALYTIC PROPERTIES OF THE BORIDES OF PLATINUM-GROUP BORIDES DANSSSR 145, 809 (1962)	300964 300964 300964
POLLACK, B (ATOMICS INTERNATIONAL CANOGA PARK CAL) THE VAPORIZATION BEHAVIOR AND THERMODYNAMIC STABILITY OF ZIRCONIUM CARBIDE AT HIGH TEMPERATURE NAA-SR-5439 (1961) J PHYS CHEM 65, 731 (1961) GR 35, 485 (1961)	700536 700536 700536 700536 700536 700536 700536
POLUBOYARINOV, D GUZMAN, I NISHANOVA, I STRUCTURE AND CERTAIN PROPERTIES OF A POROUS CERAMIC	301552 301552

ON A ZR02 BASE	301552
TR MOSK KHIM-TEKHNOLOG INST 37, 166 (1962)	301552
CA 58, 11079 (1963)	301552
POLUNINA, G KOVBA, L IPPOLITOVA, E	201624
PRODUCTS OF REACTION BETWEEN ZNO AND U3O8	201624
ISSUED V OBL KHIM URANA SB STATE I 1961, (1961)	201624
CA 57, 3067 (1962)	201624
POOLE, D HUME-ROTHERY, W	300208
THE EQUILIBRIUM DIAGRAM OF THE SYSTEM NICKEL-TITANIUM	300208
JOURNAL INST OF METALS 83, 473 (1955)	300208
POP0V, M GALCHENKO, G SENIN, M	601153
TRUE HEAT CAPACITY OF UO2, U3O8, AND UO3 AT HIGH TEMPERATURES	601153
ZHUR NEORG KHIM 3, 1734 (1958)	601153
CA 53, 21119 (1959)	601153
POP0V, A GLOCKER, G	400524
(STATE UNIV OF IOWA IOWA CITY IOWA)	400524
THE EXISTENCE OF THE HIGHER OXIDES OF NO	400524
J AM CHEM SOC 71, 4114 (1949)	400524
CA 44, 2880 (1950)	400524
POP0V, M IVANOV, M	601086
HEATS OF FORMATION OF PUO2 AND U3O8	601086
SOVIET J ATOMIC ENERGY 2, 439 (1957)	601086
CA 52, 12540 (1958)	601086
POP0V, Y G	301321
LATTICE STRUCTURE OF TITANIUM AND VANADIUM MONOXIDES	301321
ZHUR OSHCHEI KHIM 32, 2077 (1962)	301321
COTS 65, 310 (1963)	301321
POP0VA, O KABANNIK, G	300960
CHEMICAL PROPERTIES AND ANALYSIS OF SOME NITRIDES	300960
FTD-TT-62-1825	300960
TRUDY INSTITUT METALL I SPET SPLAVOV SEMINAR PO ZHAR	300960
MATERIALAM NO 6, 64 (1960)	300960
COTS NO 60, 84 (1962)	300960
POP0VA, O	201082
CHROMIUM NITRIDES	201082
UKRAIN KHIM ZHUR 27, 22 (1961)	201082
CA 55, 17328 (1961)	201082
POPPER, P	601632
SPECIAL CERAMICS. PROCEEDINGS OF A SYMPOSIUM HELD AT THE	601632
BRITISH CERAMIC RESEARCH ASSOCIATION	601632
ACADEMIC PRESS NEW YORK (1960)	601632
NSA 16, 19266 (1962)	601632
PORT, J	700976
(CHOSE BRASS AND COPPER CO WATERBURY CONN)	700976
RHENIUM-A PROMISING REFRACTORY MET.	700976
MATERIALS IN DESIGN ENG 51, 140 (1960)	700976
NSA 15, 1880 (1961)	700976
PORTNOI, K LEVINSKII, Y FADEEVA, V	300215
REACTION WITH CARBON OF SOME REFRACTORY CARBIDES AND THEIR	300215
SOLID SOLUTIONS	300215
IZVEST AKAD NAUK SSSR OTD TEKH NAUK MFT I TOPL0VA NO 2 147	300215
(1961)	300215

CA 55, 19696 (1961)	300215
NSA 15, 25248 (1961)	300215
PØRTNØY, K SAMSØNØV, G SØLØNNIKØVA, L	300144
ALLØYS IN THE SYSTEM B-SI-C	300144
ZHUR NEØRG KHIM 5, 2032 (1960)	300144
CA 55, 6329 (1961)	300144
PØRTNØY, K	700944
PRØPERTIES ØF BØRIDE-BASE MATERIALS AND ØTHER HIGH MELTING	700944
CØMPØUNDS	700944
(ISSLEDØVANIE SPLAVØV TSVETNYKH METAL)	700944
AKAD NAUK SSR INST MET IM AA BAIKØVA NØ 2, 197 (1960)	700944
NP-TR-510	700944
NSA 15, 21161 (1961)	700944
PØRTNØY, K SAMSØNØV, G FRØLØVA, K	300485
SØME PRØPERTIES ØF THE ALLØYS ØF TITANIUM BØRIDE AND CHRØMIUM	300485
TITANIUM BØRIDE WITH BØRØN CARBIDE	300485
PLANSEEBER PULVERMET 8, 195 (1961)	300485
BHT NØ 3, 9 (1961)	300485
PØST, B MØSKØWITZ, D GLASER, F	601017
(PØLYTECH INST BRØØKLYN NEW YØRK)	601017
BØRIDES ØF RARE EARTH AND RELATED METALS	601017
PLANSEE PRØC 1955, 173 (1956)	601017
CA 50, 13637 (1956)	601017
PØWELL, R BLANPIED, W	600906
THERMAL CØNDUCTIVITIES ØF METALS AND ALLØYS AT LØW	600906
TEMPERATURES. A REVIEW ØF THE LITERATURE	600906
NBS-C-556, (1954)	600906
PØWELL, R TYE, R	601082
(NATL PHYSICS LAB TEDDINGTON ENGLAND)	601082
THERMAL CØNDUCTIVITY MEASUREMENTS DØWN TØ -190 DEGREES	601082
IRIDIUM AND RHØDIUM	601082
CØNGR INTERN FRØID 9 PARIS 1955 CØMPT REND TRAV CØMM 1 ET 2,	601082
2083	601082
CA 52, 15223 (1958)	601082
PØWELL, R TYE, R	700652
THE THERMAL AND ELECTRICAL CØNDUCTIVITY ØF TITANIUM AND ITS	700652
ALLØYS	700652
J LESS CØMMØN METALS 3, 226 (1961)	700652
PØWELL, R TYE, R	700653
THE THERMAL AND ELECTRICAL CØNDUCTIVITIES ØF ZIRCØNIUM AND ØF	700653
SØME ZIRCØNIUM ALLØYS	700653
J LESS CØMMØN METALS 3, 202 (1961)	700653
PØWERS, H WELCH, F TRICE, J	601444
(FAIRCHILD ENG AIR PL CØ ØAK RIDGE TENN)	601444
THE HEAT CAPACITY ØF U3Ø8 AS A FUNCTION ØF	601444
TEMPERATURE (400-1800 DEGREES F)	601444
NEPA-934 (APR 26, 1949- DECL JULY 18, 1961)	601444
NSA 16, 5304 (1962)	601444
PØWERS, R	201184
(SYLVANIA-CØRNING NUC CØRP NEW YØRK NY)	201184
THE EFFECT ØF SØLID-SØLUTION ADDITIØNS ØN THE THERMAL	201184
CØNDUCTIVITY ØF UØ2	201184
US AT ENERGY CØMM SCNC-317 (1960)	201184

CA 56, 35 (1962)	201184
PRANDTL, W	601408
THE ABSORPTION SPECTRA OF THE RARE EARTHS AND THEIR	601408
SIGNIFICANCE FOR THE INVESTIGATION OF THE EMISSION SPECTRA IN	601408
GENERAL	601408
NATURW RUNDSCHAU 2, 57 (1949)	601408
NSA 3, 664 (1949)	601408
PRASAD, S	202120
IL S COLLEGE MUZAFFAPUR INDIA)	202120
FRANCK-CONDON FACTORS AND R-CENTROIDS FOR THE 2 DELTA-	202120
2 DELTA SYSTEM OF VO AND A SYSTEM OF TI0	202120
PROC PHYS SOC 82, 527 (1963)	202120
CA 59, 8255 (1963)	202120
PRASAD, S	301553
UNIV BIHAR BIHAR INDIA)	301553
FRANCK-CONDON FACTORS AND R-CENTROIDS FOR THE ALPHA-	301553
SYSTEM OF TI0	301553
PROC PHYS SOC (LONDON) 79, 1078 (1962)	301553
CA 58, 4037 (1963)	301553
PRATHER, J	201032
(BEL0IT COLL BEL0IT WISCONSIN)	201032
ATOMIC ENERGY LEVELS IN CRYSTALS	201032
NATL BUR STANDARDS US MONOGRAPH 19, (1961)	201032
CA 55, 14070 (1961)	201032
PREDVODITELEV, A	400605
THE AERODYNAMICS OF RAREFIED GASES, AND HEAT TRANSFER PROBLEMS	400605
TEZISY DOKLADOV I SOBSHCHENIY NA SOVESHCHANII	400605
PO TEPL0 I MASSO0BMENU, MINSK, AN BELORUSSKOY SSR (1961)	400605
PREDVODITELEV, A S	301322
CRITICAL PHENOMENA OF LIQUIDS AND GASES	301322
INZH FIZ ZH AKAD MAUK BELORUSSK SSR 6, NO 4, 123 (1963)	301322
CT NO 12, 85 JUNE 10 (1963)	301322
PREISINGER, A	300963
STRUCTURE OF STISHOVITE, HIGH-PRESSURE SILICA	300963
NATURWISS 49, 345 (1962)	300963
PREMASWARUP, D	301323
VIBRATIONAL ANALYSIS OF THE TANTALUM OXIDE BANDS	301323
IND J PHYSIC 29, 109 (1955)	301323
CA 51, 7850F (1957)	301323
PREMASWARUP, D BARR0W, R	600918
(OXFORD UNIV OXFORD ENGLAND)	600918
ROTATIONAL ANALYSIS OF THE TANTALUM OXIDE BANDS	600918
NATURE 180, 602 (1957)	600918
CA 52, 2538 (1958)	600918
PRESCOTT, C HINCKE, W	900116
THE HIGH-TEMPERATURE EQUILIBRIUM BETWEEN THORIUM OXIDE AND	900116
CARBON	900116
J AM CHEM SOC 49, 2744 (1927)	900116
CA 22, 346 (1928)	900116
PRICE, E TAYLOR, B	601473
(INT NICKEL CO LONDON ENGLAND)	601473
TEMPERATURE COEFFICIENT OF ELECTRICAL RESISTANCE OF HIGH	601473

PURITY RHODIUM	601473
NATURE 195, 272 (1962)	601473
BHT NO 3, 9 (1962)	601473
PRIEST, H PRIEST, G	601147
(COLUMBIA UNIV NEW YORK NEW YORK)	601147
DETERMINATION OF DENSITIES OF SEVERAL URANIUM COMPOUNDS	601147
US AT ENERGY COMM TID-5290 2, 734 (1958)	601147
CA 53, 18579 (1959)	601147
PRIGENT, J	200934
PREPARATION, PROPERTIES, AND SPECTRAL STUDY OF URANIUM	200934
BROMIDES AND OXYBROMIDES	200934
ANN CHIM 5, 65 (1960)	200934
CA 55, 9137 (1961)	200934
PRILEZHAEVA, N KOKHANENKO, V	301153
ESTABLISHMENT OF THERMODYNAMIC EQUILIBRIUM IN DISCHARGES	301153
NEKOTORYE VOPR EMISSION I MOLEKUL SPEKTROSKOPII KRASNØYARSK	301153
SB (1960)	301153
BHT NO 7, 17 (1963)	301153
PRISELKOV, Y SAPØZHNIKOV, Y TSEPLYAEVA, A	300142
MEASUREMENT OF THE SATURATED VAPOR PRESSURE OF BORON	300142
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK MET I TOPLIVA 1, 134	300142
(1960)	300142
CA 55, 6086 (1961)	300142
PRISELKOV, Y SAPØZHNIKOV, Y TSEPLYAEVA, A KAEELIN, V	300423
A FEW PROBLEMS ON ACCURACY OF EFFUSION METHOD	300423
CA 54, 21908 (1960)	300423
PRITCHARD, H	301554
(UNIV MANCHESTER MANCHESTER ENGLAND)	301554
THE DISSOCIATION OF DIATOMIC MOLECULES AND THE	301554
RECOMBINATION OF ATOMS	301554
J PHYS CHEM 66, 2111 (1962)	301554
CA 58, 8415 (1963)	301554
PRØKØSHKIN, D VASILEVA, E	201974
THE OXIDATION OF CERTAIN BINARY ALLOYS BASED ON NIOBIUM	201974
ISSLED PO ZHARØPRØCH SPLAVAM AKAD NAUK SSSR	201974
INST MET 9, 164 (1962)	201974
CA 58, 1208 (1963)	201974
PRØPHET, H STULL, D	300961
HEAT CAPACITIES OF BORON NITRIDE AND ALUMINUM OXIDE USING	300961
AN ARC-IMAGE FURNACE	300961
J CHEM ENG DATA 8, 78 (1963)	300961
PRØPIN, R	201031
CALCULATION OF THE PROBABILITY OF AUTOIONIZATION IN THE IONS	201031
HE- AND BE+	201031
ØPTIKA I SPEKTRØSKØPIYA 10, 308 (1961)	201031
CA 55, 14062 (1961)	201031
PRØSHINA, Z REZUKHINA, T	201249
DETERMINATION OF THE HEAT OF FORMATION OF MN	201249
AND NI TUNGSTATES	201249
ZHUR NEØRG KHIM 5, 1016 (1960)	201249
CA 56, 2046 (1962)	201249

PROTOPOPOV, N KULGAVCHUK, V	300718
THE PULSE METHOD OF DETERMINING ENERGY OF SUBLIMATION	300718
OF METALS AND ALLOYS	300718
INZHEN FIZ ZH (USSR) 4, NO 7, 84 (1961)	300718
PRZYBYLSKA, M REDDICH, A RITTER, G	300962
PREPARATION AND STRUCTURE OF LUTETIUM DIBORIDE,	300962
SCANDIUM DODECABORIDE, AND LUTETIUM ANTIMONIDE	300962
J AM CHEM SOC 85, 407 (1963)	300962
PUGACHEVICH, P LAZAREV, V	200878
APPARATUS FOR MEASURING THE SURFACE TENSION OF METALS AT HIGH	200878
TEMPERATURES	200878
ZHUR FIZ KHIM 34, 2607 (1960)	200878
CA 55, 6066 (1961)	200878
PUGH, H LEES, J BLAND, J	600842
SYNTHESIS AND X-RAY ANALYSIS OF DIAMOND	600842
NATURE 191, 865 (1961)	600842
PURDY, G PARR, J	300279
TITANIUM-NICKEL SYSTEM BETWEEN DITITANIUM NITRIDE AND	300279
TITANIUM NITRIDE	300279
TRANS MET SOC AIME 215, 636 (1961)	300279
PURT, G	301555
(LAB CERBERUS A G MAENNEDØRG SWITZERLAND)	301555
THE BINARY SYSTEM BA0-W03	301555
Z PHYSIK CHEM (FRANKFURT) 35, 133 (1962)	301555
CA 58, 8447 (1963)	301555
PUTILOV, K MELNICHENKO, N	300602
NEW FORMULA FOR SATURATED VAPOR PRESSURE	300602
ZHUR FIZ KHIM 36, 1611 (1962)	300602
QUILL, L	400553
(MICHIGAN STATE COLL EAST LANSING MICH)	400553
RESEARCHES IN RARE EARTH CHEMISTRY	400553
RECORD CHEM PROG 11, 151 (1950)	400553
CA 45, 1827 (1951)	400553
RABENAU, A	301324
(PHILIPS ZENTRALLAB	301324
SILICON NITRIDE A REFRACTORY MATERIAL	301324
BER DEUT KERAM GES 43, 6 (1963)	301324
BHT NO 2, 31 (1963)	301324
RABINOVICH, I	300975
ISOTOPE EFFECT IN VAPOR PRESSURE	300975
USP KHIM 31, 101 (1962)	300975
RACAH, G	400547
ON THE SPECTRUM OF TH III	400547
PHYSICA 16, 651 (1950)	400547
CA 45, 5020 (1951)	400547
NSA 5, 734 (1951)	400547
RAKOVSKII, V S	301325
SOME PROPERTIES OF REFRACTORY METAL-CERAMIC ALLOYS	301325
ABHADL DEUT AKAD WISS BERLIN KL MATH PHYSIK TECH 1962 NO 1,	301325
381 (1962)	301325

CA 59, 2467B (1963)	301325
RALEIGH, D	201698
(ATS INTERN CANOGA PARK CALIF)	201698
EQUILIBRIUM STUDIES IN THE REDUCTION OF THORIUM OXIDE BY	201698
ALUMINUM	201698
J ELECTROCHEM SOC 109, 521 (1962)	201698
CA57, 4432 (1962)	201698
RAMAN, S RAMACHANDRAN, G	300561
STRUCTURE OF A NEW CARBIDE OF TITANIUM	300561
CURRENT SCI (INDIA) 31, NO 8, 321 (1962)	300561
RAMANATHAN, K SPRINIVASAN, T	601132
(NATL PHYS LAB NEW DELHI INDIA)	601132
ATOMIC HEATS OF GOLD, PLATINUM, AND ANTIMONY AT LIQUID-HELIUM	601132
TEMPERATURES	601132
PROC INDIAN ACAD SCI 49A, 55 (1959)	601132
CA 53, 13761 (1959)	601132
RAMBIDI, N SPIRIDONOV, V ALEKSEEV, N	301389
PRESENT STATE OF GAS ELECTRON-DIFFRACTION EFFECT OF	301389
MOVEMENTS OF NUCLEI ON THE SCATTERING OF ELECTRONS BY	301389
MOLECULES	301389
ZHUR STRUKT KHIM 3, 347 (1962)	301389
RAMBIDI, N AKISHIN, P ZASORIN, E	300763
(MOSCOW STATE UNIV MOSCOW RUSSIA)	300763
ELECTRON DIFFRACTION STUDY OF THE STRUCTURE OF UF ₄ AND UBR ₄	300763
IN THE VAPOR PHASE	300763
ZHUR FIZ KHIM 35, 1171 (1961)	300763
RAMKE, W LATVA, J	202121
(WRIGHT-PATTERSON A F B DAYTON OHIO)	202121
REFRACTORY CERAMICS AND INTERMETALLIC COMPOUNDS	202121
AEROSPACE ENG 22, 76 (1963)	202121
CA 58, 8747 (1963)	202121
RAMSTAD, H RICHARDSON, F APPENDIX BY BOWLES, P	300339
THERMODYNAMICS OF SiO	300339
TRANS MET SOC AIME 221, 924 (1961)	300339
BHT 4, 44 (1961)	300339
RAMSTAD, H RICHARDSON, F BOWLES, P	300458
THERMODYNAMICS OF SILICON MONOXIDE	300458
TRANS AIME 221, 1021 (1961)	300458
BHTG NO 4, 3 (1962)	300458
RANK, D EASTMAN, D RAO, B WIGGINS, T	600835
HIGHLY PRECISE WAVLENGTHS IN THE INFRARED II HCN N ₂ O AND CO	600835
J OPT SOC AM 51, 929 (1961)	600835
RANK, D GUENTHER, A SAKSENA, G SHEARER, J WIGGINS, T	600722
(PENN STATE UNIV UNIVERSITY PARK PENNA)	600722
TERTIARY INTERFEROMETRIC WAVE LENGTH STANDARDS FROM	600722
MEASUREMENTS ON LINES OF THE 2-0 BAND OF CARBON MONOXIDE AND	600722
DERIVED WAVE LENGTH STANDARDS FOR SOME LINES OF THE 1-0 BAND	600722
OF CARBON MONOXIDE. THE VELOCITY OF LIGHT DERIVED FROM A	600722
BAND SPECTRUM METHOD IV	600722
J OPT SOC AMER 47, 686 (1957)	600722
CA 51, 14415 (1957)	600722
RAO, C	700549

KINETICS AND THERMODYNAMICS OF THE CRYSTAL STRUCTURE TRANSFORMATION OF SPECTROSCOPICALLY PURE ANATASE TO RUTILE CAN J CHEM 39, 498 (1961)	700549 700549 700549
RAO, C YOGANARASIMHAN, S FAETH, P STUDIES ON THE BROOKITE-RUTILE TRANSFORMATION TRANS FARADAY SOC 57, 504 (1961)	700535 700535 700535
RAPP, R A (AERO RES LAB PAFB OHIO) FREE ENERGY OF FORMATION OF MOLYBDENUM DIOXIDE TRANS AIME 227, (2) 371 (1963) BHT NO 2, 36 (1933)	301326 301326 301326 301326 301326
RASE, D (N Y ST UNIV COL OF CERAMICS ALFRED NEW YORK) PHASE EQUILIBRIA BETWEEN B2O3 AND REFRACTORY OXIDES THE SYSTEMS BEO-B2O3 AND THO2-B2O3 NP-9424 (1960) NS 15, 14715 (1961)	600872 600872 600872 600872 600872 600872
RASOR, N MCCLELLAND, J (ATOMIC INTERN CANOGG PARK CAL) THERMAL PROPERTIES OF GRAPHITE, MOLYBDENUM, AND TANTALUM TO THEIR DESTRUCTION TEMPERATURES PHYS AND CHEM SOLIDS 15, 17 (1960) CA 55, 11055 (1961) NSA 15, 3133 (1961)	200960 200960 200960 200960 200960 200960
RAU, R (GEN ELEC CO CINCINNATI OHIO) CRYSTALLOGRAPHIC DATA CRYSTAL FRONT 2, NO 1, 10 (1961) CA 56, 85 (1962)	201198 201198 201198 201198 201198
RAUB, E BEESKOW, H MENZEL, D (INST EDELMETALLE GUMUEND GERMANY) PALLADIUM-RHODIUM ALLOYS AND ALLOTROPY OF RHODIUM Z METALLK 50, 428 (1959) CA56, 11329 (1962)	201473 201473 201473 201473 201473
RAUH, E THORN, R VAPOR PRESSURE OF URANIUM CONTRACT W-31-109 ENG-38 (ANL-5203) (1954) NSA 8, 2160 (1954) J CHEM PHYS 22, 1414 (1954) CA 48, 13315 (1954)	601223 601223 601223 601223 601223 601223
REDFIELD, D BAUM, R (UNION CARBIDE CORP PARMA OHIO) INFRARED CHRISTIANSEN FILTER EFFECT WITH BORON NITRIDE J OPT SOC AM 51, 184 (1961) CA 55, 12041 (1961)	200978 200978 200978 200978 200978
REID, A WILMHURST, R WYLIE, A (COMMONWEALTH SCI IND RES MELBOURNE AUSTRALIA) HIGH-TEMPERATURE PHYSICAL PROPERTIES OF CARBIDE-IODIDE THORIUM J ELECTROCHEM SOC 110, 429 (1963) CA 58, 11055 (1963)	301556 301556 301556 301556 301556 301556
REIMANN, C NEW METHOD FOR THE DETERMINATION OF ACCOMMODATION COEFFICIENTS	300469 300469

DISSERTATION ABSTR 22, 2214 (1962)	300469
BHTG N0 4, 11 (1962)	300469
REIN, R H CHIPMAN, J	301327
(MASS INST TECH CAMBRIDGE MASS)	301327
THE FREE ENERGY OF SIC FROM ITS SOLUBILITY IN FE AND FROM GAS-	301327
SOLID EQUILIBRIA WITH SiO ₂ , GRAPHITE, AND CO	301327
J PHYS CHEM 67, (4) 839 (1963)	301327
BHT N0 2, 31 (1963)	301327
REISMAN, A HOLTZBERG, F	301328
(IBM N Y N Y)	301328
THE HIGH TEMPERATURE METASABLE PHASE E	301328
J AM CHEM SOC 81, 3182 (1959)	301328
CA 53, 19544F (1959)	301328
REISMAN, A MINEO, J	201080
(INTERN BUSINESS MACHINES YORKTOWN HEIGHTS NEW YORK)	201080
COMPOUND REPETITION IN OXIDE-OXIDE INTERACTIONS. THE SYSTEM	201080
CS ₂ O-NB ₂ O ₅	201080
J PHYS CHEM 65, 996 (1961)	201080
CA 55, 17185 (1961)	201080
REISWIG, R	601378
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)	601378
THERMAL CONDUCTIVITY OF UO ₂ TO 2100 DEGREES C	601378
J AM CERAM SOC 44, 48 (1961)	601378
NSA 15, 7800 (1961)	601378
RENTZEPIS, P WHITE, D	300971
(OHIO STATE UNIV COLUMBUS OHIO)	300971
THE REACTION OF LIQUID B ₂ O ₃ AND CARBON AT ELEVATED TEMPERATURES	300971
US DEPT COM OFFICE TECH SERV PB REPT 154959 (1959)	300971
CA 57, 4108 (1962)	300971
RENUCCI, L LANGERON, J LEHR, P	201517
CENTRE ETUDES CHIM MET VITRY SUR SEINE FRANCE)	201517
ELECTRIC RESISTIVITY OF ZR APPLICATION TO THE STUDY OF	201517
THE RECRYSTALLIZATION OF THE METAL AFTER COLD WORKING	201517
INFLUENCE OF PURITY	201517
MEM SCI REV MET 58, 699 (1961)	201517
CA56, 13653 (1962)	201517
REPENKO, K N	301329
NITRIDES AND THEIR PROPERTIES	301329
SB NAUCHN TR UKR NAUCHN-ISSLED INST OGNEUPOROV 1962 (6) 100	301329
(1962)	301329
CA 59, 2172A (1963)	301329
RESHETNIKOV, F GURVICH, M	300972
MECHANISM OF NEGATIVE EFFECT OF OXYGEN-CONTAINING	300972
URANIUM COMPOUNDS ON THE COURSE AND RESULTS OF	300972
METALLOTHERMIC REDUCTION OF URANIUM TETRAFLUORIDE	300972
AT ENERGY (USSR) 13, N0 1, 54 (1962)	300972
REYAKIN, A	201286
DIFFUSION OF OXYGEN IN ALPHA-TITANIUM	201286
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK MET I TOPLIVO 1961,	201286
N0 5, 113	201286
CA 56, 3247 (1962)	201286
REZNITSKII, L	300348
APPROXIMATE CALCULATION OF HEATS OF FORMATION OF INORGANIC	300348

COMPOUNDS	300348
ZHUR FIZ KHIM 35, 1853 (1961)	300348
CCP NO. 2, 118 (1962)	300348
RICE, O	301557
(UNIV OF NORTH CAROLINA CHAPEL HILL N CAROLINA)	301557
Nonequilibrium Effects in the Dissociation of Diatomic	301557
Molecules by a Third Body	301557
J Phys Chem 67, 6 (1962)	301557
CA 58, 2871 (1963)	301557
RICHARDS, T JACKSON, F	700565
THE SPECIFIC HEATS OF THE ELEMENTS AT LOW TEMPERATURES	700565
Z Phys Chem 70, 414 (1910)	700565
CA 4, 1405 (1910)	700565
RICHARDSON, D	700817
ON BOILING POINT DETERMINATIONS BY SPECTROSCOPIC METHODS	700817
PROC FIFTH SUMMER CONF SPECTROSCOPY AND APPLICATIONS, 64	700817
(1938)	700817
RICHERT, E BECKETT, C JOHNSTON, H	601638
THERMAL, STRUCTURAL, ELECTRICAL, MAGNETIC AND OTHER PHYSICAL	601638
PROPERTIES OF THE GROUP V ELEMENTS TANTALUM, NIObIUM AND	601638
VANADIUM	601638
ATI-81819, TECHN REPT NO 102, AC49/11-100 (1949)	601638
RICHERT, E BECKETT, C JOHNSTON, H	700564
THERMAL, STRUCTURAL, ELECTRICAL, MAGNETIC AND OTHER PHYSICAL	700564
PROPERTIES OF GROUP VI ELEMENTS TUNGSTEN (WOLFRAM),	700564
MOLYBDENUM AND CHROMIUM	700564
ARMED SERVICES TECHNICAL INFORMATION AGENCY REPORT ATI-111799	700564
(1949)	700564
RICHTER, H WINCIERZ, P ANDERKO, K ZWICKER, U	201766
(METALL LAB FRANKFURT/MAIN GERMANY)	201766
THE CONSTITUTION OF ZIRCONIUM NIObIUM ALLOYS	201766
J Less Common Metals 4, 252 (1962)	201766
CA 57, 6981 (1962)	201766
RILEY, W MCCLELLAND, J	301080
BERYLLIUM COMPOUNDS	301080
SPACE I AERONAUTICS 37, (1962)	301080
REV MET LIT 19, (1962)	301080
RIVIERE, J	201805
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	201805
THE WORK FUNCTION OF URANIUM	201805
PROC PHYS SOC (LONDON) 80, 116 (1962)	201805
CA 57, 9330 (1962)	201805
RIVIERE, J	201806
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	201806
THE WORK FUNCTION OF THORIUM	201806
PROC PHYS SOC (LONDON) 80, 124 (1962)	201806
CA 57, 9330 (1962)	201806
RIZZO, H SIMMONS, W BIELSTEIN, H	601671
THE EXISTENCE AND FORMATION OF SOLID B60	601671
J Electrochem Soc 109, 1079 (1962)	601671
BHT NO 4, (1962)	601671
ROBERTS, L	601089

(RADAR RES ESTAB	MALVERN	ENGLAND)	601089
THE ATOMIC HEAT OF SAMARIUM FROM 2 TO 20 DEGREES K			601089
PROC PHYS SOC (LONDON) 70B, 434 (1957)			601089
CA 52, 12478 (1958)			601089
ROBERTS, L WALTER, A			601434
(A.E.R.E.	HARWELL	ENGLAND)	601434
EQUILIBRIUM PRESSURES AND PHASE RELATIONS IN THE			601434
URANIUM OXIDE SYSTEM			601434
J INORG AND NUCLEAR CHEM 22, 213 (1961)			601434
NSA 16, 13047 (1962)			601434
ROBINS, D			600624
(G E CO LTD	WEMBLY, MIDDX	ENGLAND)	600624
BONDING IN CARBIDES SILICIDES AND BORIDES			600624
POWDER MET NO. 1, 172 (1958)			600624
NS 14, 22074 (1960)			600624
ROBINS, R WILKS, R BRADBURY, B			201821
(ATOMIC ENERGY RES ESTAB	HARWELL	ENGLAND)	201821
THE CRYSTAL HABIT OF URANIUM DIOXIDE			201821
J NUCL MATER 5, 262 (1962)			201821
CA 57, 10596 (1962)			201821
ROBIJN, P			301558
MEASUREMENTS OF AVERAGE SPECIFIC HEAT OF REFRACTORIES			301558
SILICATES IND 28, 247 (1963)			301558
CA 59, 5859 (1963)			301558
ROBSON, H			300275
(U. OF KANSAS	LAWRENCE	KANSAS)	300275
VAPOR PRESSURE AND THERMODYNAMIC PROPERTIES OF BORON CARBIDE			300275
THESIS, U OF KANSAS (1958)			300275
RODE, E LYSANOVA, G			201843
SYNTHESIS AND PHYSICO-CHEMICAL STUDY OF THE OXYGEN COMPOUNDS			201843
IN THE SYSTEM MOO3-MOO2			201843
DOKL AKAD NAUK SSSR 145, 351 (1962)			201843
CA 57, 11908 (1962)			201843
RODIGINA, E GOMELSKII, K			700966
(INST OF METROLOGY		USSR)	700966
ENTHALPY OF BERYLLIUM AND LITHIUM OXIDES AT HIGH TEMPERATURES			700966
ZHUR FIZ KHIM 35, 1828 (1961)			700966
NSA 15, 30690 (1961)			700966
CA 56, 76 (1962)			700966
RODIGINA, E GOMELSKII, K LUGININA, V			201194
(RES INST METROL	SVERDLOVSK	RUSSIA)	201194
ENTHALPY AND SPECIFIC HEAT OF YELLOW LEAD MONOXIDE AT			201194
HIGH-TEMPERATURES			201194
ZHUR KHIM FIZ 35, 1799 (1961)			201194
CA 56, 76 (1962)			201194
RAUH, E			601261
(ARGONNE NATL LAB	LEMONT	ILL)	601261
WORK FUNCTION, IONIZATION POTENTIAL AND EMISSIVITY OF URANIUM			601261
ANL 5534 (1956)			601261
NSA 10, 5025 (1956)			601261
ROCHER, Y A			301559
(UNIV PARIS	PARIS	FRANCE)	301559
ELECTRONIC STRUCTURE OF RARE EARTH METALS			301559

ADVAN PHYS 11, 233 (1962)	301559
CA 58, 10739G (1963)	301559
RØESER, W CALDWELL, F WENSEL, H	900135
THE FREEZING POINT OF PLATINUM	900135
J RESEARCH NATL BUR STANDARDS 6, 1119 (1931)	900135
CA 25, 4757 (1931)	900135
RØESER, W WENSEL, H	900134
METHODS OF TESTING THERMOCOUPLES AND THERMOCOUPLE MATERIALS	900134
J RESEARCH NATL BUR STANDARDS 14, 247 (1935)	900134
CA 29, 4214 (1935)	900134
RØESER, W WENSEL, H WICHERS, E	900141
THE FREEZING POINT OF RHODIUM	900141
J RESEARCH NATL BUR STANDARDS 12, 519 (1934)	900141
CA 28, 4645 (1934)	900141
RØGERS, B	601266
PROGRESS REPORT IN METALLURGY FOR APR 1, 1950 TO	601266
SEPT 30, 1950	601266
ISC-128	601266
NSA 10, 4307 (1956)	601266
RØGØSA, G SCHWARZ, G	500124
(FLORIDA STATE UNIV TALLAHASSEE FLORIDA)	500124
MOLYBDENUM K AND URANIUM L X-RAY TRANSITIONS FROM SEPARATED	500124
ISOTOPES	500124
PHY REV 92, 1434 (1953)	500124
CA 48, 4964 (1954)	500124
RØKHLIN, L	201703
SOLUBILITY OF NEODYMIUM AND CERIUM IN MAGNESIUM IN THE SOLID	201703
STATE	201703
IZV AKAD NAUK SSSR OTD TEKHNI YAK MET I TOPLIVO 2, 126 (1962)	201703
CA 57, 4439 (1962)	201703
RØLIN, M BERNARD, M	300730
(INST NATL SCI APPL VILLEURBANNE FRANCE)	300730
IONIC STRUCTURE OF FUSED PURE CRYOLITE. V. CRYOMETRIC	300730
MEASUREMENT OF THE MOLECULAR HEAT OF FUSION OF CRYOLITE	300730
BULL SOC CHIM FRANCE 1962, 423 (1962)	300730
CA 57, 2927 (1962)	300730
RØLLA, L IANDELLI, A CANNERI, G VØGEL, R	900103
STUDY OF RARE EARTH METALS AND ALLOYS	900103
Z METALLKUNDE 35, 29 (1943)	900103
CA 38, 47 (1944)	900103
RØLLEFSØN, G HAGEMANN, F	601106
CHEMISTRY OF THORIUM	601106
U S ATOMIC ENERGY COMM TID-5222, 144 (1951)	601106
CA 52, 4372 (1958)	601106
RØLSTEN, R	200786
(E I DU PONT DE NEMOURS, CO GIBBSTOWN N J)	200786
THE PREPARATION OF VERY PURE METALS FROM THEIR IODIDES	200786
Z ANORG U ALLGEM CHEM 305, 25 (1960)	200786
CA 55, 195 (1961)	200786
RØMANOVSKII, V	300978
HEAT CAPACITY OF VITREOUS CRYSTALS AT LOW TEMPERATURES	300978
ZH FIZ KHIM 36, NO 11, 2550 (1962)	300978

R00F, R KEMPTER, C	300966
(LOS ALAMOS SCI LAB LOS ALAMOS N MEX)	300966
NEW ORTHORHOMBIC PHASE IN THE RUTHENIUM-BORON AND	300966
OSMIUM-BORON SYSTEMS	300966
J CHEM PHYS 37, 1473 (1962)	300966
 ROSE, A BLANDIN, J	201807
J RECH CTR NAT RECH SCI LAB PARIS NO 53, 309 (1960)	201807
X-RAY EMISSION SPECTROSCOPY I. A CURVED CRYSTAL	201807
SPECTROGRAPH	201807
III. SPECTRA OF THE RARE EARTHS OBTAINED BY A CURVED	201807
CRYSTAL SPECTROGRAPH	201807
CA 57, 9357 (1962)	201807
 ROSE, R	601392
(U K AT EN AUT IND GR HQ RISLEY ENGLAND)	601392
A NOTE ON THE THERMAL CONDUCTIVITY OF UO2	601392
IGR-TM/R-0175, (1958)	601392
NSA 15, 619 (1961)	601392
 ROSEN, B	301560
(UNIV LIEGE LIEGE BELGIUM)	301560
NEW BAND SYSTEMS OF THE TiO AND ZRO	301560
PROC INTERN MEETING MOL SPECTRY 4TH, BOLOGNA 1959 2, 533	301560
(1962)	301560
CA 59, 3436B (1963)	301560
 ROSEN, B	700890
DONNEES SPECTROSCOPIQUES CONCERNANT LES MOLECULES DIATOMIQUES	700890
HERMANN AND CIE (PARIS) (1951)	700890
 ROSEN, B WENIGER, S	301561
(UNIV LIEGE LIEGE BELGIUM)	301561
THE ELECTRONIC SPECTRA ATTRIBUTED TO THE OXIDES OF CALCIUM	301561
PROC INTERN MEETING MOL SPECTRY 4TH, BOLOGNA, 1959 2, 535	301561
(1962)	301561
CA 59, 3442B (1963)	301561
 ROSENBERY, J	201392
(UNIV OF DAYTON DAYTON OHIO)	201392
EFFECTS OF MOLTEN BORON OXIDE ON HIGH-TEMPERATURE MATERIALS	201392
US DEPT COMM OFFICE TECH SERV PB REPT 161,703, (1960)	201392
CA 56, 840B (1962)	201392
 ROSENBLATT, G M	301562
(UNIV OF CALIFORNIA BERKELEY CALIF)	301562
INTERPRETATION OF KNUDSEN VAPOR-PRESSURE MEASUREMENTS ON	301562
POROUS SOLIDS	301562
J ELECTROCHEM SOC 110, 563 (1963)	301562
CA 58, 13157A (1963)	301562
 ROSENBLUM, B NETHERCOT, A	600723
(COLUMBIA UNIV N Y NEW YORK)	600723
QUADRUPLE COUPLING CONSTANT AND MOLECULAR STRUCTURE OF CARBON	600723
MONOXIDE-017	600723
J CHEM PHYS 27, 828 (1957)	600723
CA 52, 1754 (1958)	600723
 ROSENBLUM, B NETHERCOT, A TOWNES, C	600724
(COLUMBIA UNIV N Y NEW YORK)	600724
ISOTOPIC MASS RATIOS, MAGNETIC MOMENTS, AND THE SIGN OF THE	600724
ELECTRIC DIPOLE MOMENT IN CARBON MONOXIDE	600724

PHYS REV 109, 400 (1958)	600724
CA 57, 9758 (1958)	600724
RÖSENSTÖCK, H	700643
(U S NAVAL RES LAB WASHINGTON D C)	700643
ATOMIC FORCES AND THERMAL EFFECTS IN SOLIDS	700643
J CHEM PHYS 35, 420 (1961)	700643
RÖSENSTÖCK, H B	301563
(U S NAVAL RES LAB WASHINGTON D C)	301563
VIBRATIONAL CONTRIBUTIONS TO SPECIFIC HEAT NEAR PHASE	301563
CHANGES	301563
US DEPT COM OFFICE TECH SERV AD 257465 (1961)	301563
CA 58, 7390D (1963)	301563
RÖSENZWEIG, N PORTER, C	700996
(ANL LEMONT ILL)	700996
REPULSION OF ENERGY LEVELS IN COMPLEX ATOMIC SPECTRA	700996
PHYS REV 120, 1698 (1960)	700996
NSA 15, 5541 (1961)	700996
RÖSS, A	601493
(AT ENG OF CAN LTD CH RI PRØ CHALK RIVER ØNT)	601493
A LITERATURE SURVEY ON THE MEASUREMENT OF THERMAL CONDUCTIVITY	601493
OF SEVERAL SOLIDS INCLUDING UØ2	601493
CRFD-762 (1958)	601493
NSA 12, 10679 (1958)	601493
RÖSTÖKER, W	201396
(ILLINOIS INST OF TECHNØL CHICAGO ILL)	201396
TERNARY PHASE DIAGRAMS OF TUNGSTEN AND TANTALUM	201396
US DEPT COMM OFFICE TECH SERV PB REPT 161,709, (1960)	201396
CA 56, 8420 (1962)	201396
RÖTH, E MARGERUM, E AMICK, J	300970
EVAPØRATION OF SILICON AND GERMANIUM BY RF LEVITATION	300970
REV SCI INST 33, 686 (1962)	300970
RÖTH, R WARING, J	201406
PHASE EQUILIBRIUM RELATIONS IN THE BINARY SYSTEM BARIUM-ØXIDE	201406
NIØBIUM PENTØXIDE	201406
J RESEARCH NATL BÜR STANDARDS 65A, 337 (1961)	201406
CA 56, 9480 (1962)	201406
RÖTHMAN, A	202122
(UNIV CALIFØRNIA BERKELEY CALIFØRNIA)	202122
PROPERTIES OF BEØ CERAMICS AND THEIR APPLICATION IN A	202122
NUCLEAR PROPULSION SYSTEM (PLUTØ)	202122
U S AT ENERGY COMM UCRL-6743 (1962)	202122
CA 58, 8746 (1963)	202122
RÖTHWELL, E	601476
(AERE HARWELL ENGLAND)	601476
HIGH TEMPERATURE SUBSTØICHIØMETRY IN URANIUM DIØXIDE	601476
J NUCL MATR 6, 229 (1962)	601476
BHT NØ 3, 28 (1962)	601476
RÖTT, L A	301331
ON THE THEORY OF MELTING	301331
FIZIKA TVERDØGØ TELA 4, 577 (1962)	301331
CØTS 66, 234 (1963)	301331
RØUGH, F CHUBB, W	700568

AN EVALUATION OF DATA ON NUCLEAR CARBIDES US ATOMIC ENERGY COMMISSION BMI 1441, MAY 31, 1960, 100	700568 700568
ROWLINSON, H BARRON, R (OXFORD UNIV OXFORD ENGLAND) ABSORPTION BAND SYSTEMS OF SILICON OXIDE AND GERMANIUM OXIDE IN THE SCHUMANN REGION J CHEM PHYS 21, 378 (1953) CA 47, 9145 (1953)	600916 600916 600916 600916 600916 600916
RUBESKA, I (CENTRAL GEOL SURV PRAGUE CZECH SPECTROCHEMICAL DETERMINATION OF ZIRCONIUM AND LANTHANUM IN RIVER SANDS CHEM ANAL (WARSAW) 7, 405 (1962) CA 58, 15 (1963)	500119 500119 500119 500119 500119 500119
RUDKIN, R (US NAVAL RAD DEF LAB SAN FRANCISCO CALIFORNIA) THERMAL PROPERTIES OF MOLYBDENUM BETWEEN 2700 AND 4000 DEGREES R US DEPT COM. OFFICE TECH. SERV. P B REPT 155,829 16 PP (1962) CA 57,13511 (1962)	201901 201901 201901 201901 201901 201901
RUDKIN, R PARKER, W WESTOVER, R (NAVAL RADIOLOGICAL DEF LAB SAN FRANCISCO CALIF) MEASUREMENTS OF THE THERMAL PROPERTIES OF METALS AT ELEVATED TEMPERATURES USNRDL TR 419, (1960) NS 14, 20621 (1960)	600614 600614 600614 600614 600614
RUDNEVA, A V MODEL, M S PHASE TRANSFORMATIONS DURING REDUCTION OF TITANIUM DIOXIDE IN SLAG SYSTEMS IZV AKAD NAUK SSSR OTD TEKH NAUK MET I GORN DEL 1963, NO 1, 59 (1963) CA 58, 11011B (1963)	301564 301564 301564 301564 301564 301564
RUDY, E THERMODYNAMICS OF PHASE REACTIONS IN TERNARY SYSTEMS Z METALLK 54, 112 (1963) CA 58, 12239 (1963)	301565 301565 301565 301565
RUDY, E BENESOVSKY, F (METALLWERK PLANSEE A G REUTTE AUSTRIA) THE SYSTEMS THORIUM-MOLYBDENUM-CARBON AND URANIUM-MOLYBDENUM- CARBON MONATSH 94, 85 (1963) CA 58, 12248 (1963)	301566 301566 301566 301566 301566
RUDY, E BENESOVSKY, F NOWOTNY, H TOTH, L (UNIV VIENNA VIENNA AUSTRIA) CRYSTAL STRUCTURE OF HfBE ₂ , HfBE ₁₃ AND HfBESi PARTIAL SYSTEMS MBE ₂ -MB ₂ -MSi ₂ (M EQUALS Zr, Hf) MONATSH CHEM 92, 692 (1961) CA 56, 2063 (1962)	201255 201255 201255 201255 201255 201255
RUDY, E THE THERMODYNAMICS OF PHASE CHANGES IN TERNARY SYSTEMS PLANSEEBERICHTE FUR PULVERMETALLURGIE 10, 32 (1962)	900228 900228 900228
RUDY, E BENESOVSKY, F	200808

THE ELECTRICAL CONDUCTIVITY OF HIGH-MELTING HARD CARBIDES AND CARBIDE MIXED CRYSTALS PLANSEEBER PULVERMET 8, 72 (1960) CA 55, 2221 (1961)	200806 200808 200808 200808
RUDY, E BENESOVSKY, F INVESTIGATION IN THE NI0BIUM-M0LYBDENUM CARB0N SYSTEM M0NATSH CHEM 92, 841 (1961) C0TS N0 53, 130 (1962)	300449 300449 300449 300449
RUDY, E BENESOVSKY, F INVESTIGATIONS IN THE SYSTEMS HF-B-N AND ZR-B-N M0NATSH CHEM 92, 415 (1961) BHT N0 3, 10 (1961)	300486 300486 300486 300486
RUDY, E BENESOVSKY, F RUDY, F (METALLWERK PLANSEE A-G REUTTE AUSTRIA) THE SYSTEMS, TH0RIUM-TUNGSTEN-CARB0N AND URANIUM-TUNGSTEN CARB0N M0NATSH 93, 522 (1962) CA57, 3150 (1962)	201628 201628 201628 201628 201628
RUDY, E BENESOVSKY, F SYSTEM TH0RIUM-ZIRC0NIUM-CARB0N M0NATSH CHEM 93, N0 6, 1279 (1962)	300969 300969 300969
RUDY, E BENESOVSKY, F SYSTEM VANADIUM-TUNGSTEN-CARB0N M0NATSH CHEM 93, 693 (1962)	300630 300630 300630
RUDY, E KIEFFER, B FR0EHLICH, H THE SYSTEM RUTHENIUM-RHENIUM Z METALLK 53, 90 (1962) CA 56, 15259 (1962)	201556 201556 201556 201556
RUDY, E RUDY, E STUDIES 0N THE VANADIUM-M0LYBDENUM-CARB0N SYSTEM PLANSEEBERICHTE FUER PULVERMETALLURGIE 10, 42 (1962) AEC-TR-5459	900222 900222 900222 900222
RUDY, E RUDY, E BENESOVSKY, F SYSTEM TANTALUM-TUNGSTEN-CARB0N M0NATSH CHEM 93, 1176 (1962)	300967 300967 300967
RUDY, E N0W0TNY, H HAFNIUM-TANTALUM-CARB0N SYSTEM M0NATSH 94, 507 (1963) CA 59, 7209 (1963)	301165 301165 301165 301165
RUDY, E BENESOVSKY, F (METALLWERK PLANSEE AG REUTTE TIR0L AUSTRIA) INVESTIGATIONS 0F THE SYSTEMS TH-M0-C AND U-M0-C M0NATSH CHEM 94, (1), 85 (1963) CHEM 94, (1), 85 (1963) BHT N0 2, 40 (1963)	301332 301332 301332 301332 301332
RUDY, E BENESOVSKY, F (METALLWERK PLANSEE AG REUTTE TIR0L AUSTRIA) STABILITY 0F UC2 AND THE C-STABLE REGIONS IN THE SYSTEMS 0F UC WITH ZRC, HFC, NBC AND TAC M0NATSH CHEM 94, (1) 204 (1963) BHT N0 2 (1963)	301333 301333 301333 301333 301333

RUDY, E STECHER, P	300974
THE SYSTEM HAFNIUM-OXYGEN	300974
J LESS COMMON METALS 5, NO 1, 78 (1963)	300974
RUE, R	301335
(IOWA STATE UNIV AMES IOWA)	301335
THEORETICAL ANALYSIS OF CHEMICAL BINDING IN HOMONUCLEAR	301335
DI-ATOMIC MOLECULES	301335
UNIV MICROFILMS (ANN ARBOR, MICH), ORDER NO 63-2996, 118	301335
DISSERTATION ABSTR 23, 3652 (1963)	301335
CA 59, 2177F (1963)	301335
RUEDENBERG, K	300973
(IOWA STATE UNIV AMES IOWA)	300973
THE PHYSICAL NATURE OF THE CHEMICAL BOND	300973
REV MODERN PHYSICS 34, 326 (1962)	300973
RUEDORFF, W KEMMLER, S LEUTNER, H	201775
(UNIV TUEBINGEN GERMANY)	201775
TERNARY URANIUM (V) OXIDES	201775
CA 57, 7999 (1962)	201775
RUFF, O EBERT, F WÖITINEK, H	900120
CONTRIBUTIONS TO THE CERAMICS OF HIGHLY REFRACTORY MATERIALS	900120
III. THE SYSTEM ZIRCONIA-THORIA	900120
Z ANORG CHEM 180, 252 (1929)	900120
CA 23, 5020 (1929)	900120
RUH, R	202124
REACTIONS OF ZIRCONIA AND TITANIUM AT ELEVATED TEMPERATURES	202124
J AM CERAM SOC 46, 301 (1963)	202124
RUNDLE, R BAENZIGER, N NEWTON, A DAANE, A BUTLER, T	601140
JOHNS, I TUCKER, W FIGARD, P	601140
(IOWA STATE COLL. AMES IOWA)	601140
URANIUM-NITROGEN SYSTEM	601140
US AT ENERGY COMM TID-5290, 1, 131 (1958)	601140
CA 53, 15846 (1959)	601140
RUNDLE, R BAENZIGER, N WILSON, A	601142
(IOWA STATE COLL. AMES IOWA)	601142
X-RAY STUDY OF THE URANIUM OXYGEN SYSTEM	601142
US AT ENERGY COMM TID-5290, 1, 131 (1958)	601142
CA 53, 16672 (1959)	601142
RUNDLF, R BAENZIGER, N TEVERAUGH, A	601112
(IOWA STATE COLL AMES IOWA)	601112
X-RAY ANALYSIS OF THE URANIUM-CARBON SYSTEM	601112
CA 53, 16672 (1959)	601112
RUNDQUIST, S	300546
X-RAY INVESTIGATIONS OF THE TERNARY FE-P-B	300546
SOME FEATURES OF THE SYSTEMS CI-P-B, MN-P-B, CO-P-B, AND	300546
NI-P-B	300546
ACTA CHEM SCAND 16, 1 (1962)	300546
BHT NO 2, 44 (1962)	300546
RUNNALLS, O	200970
(ATOMIC ENERGY OF CANADA LTD CANADA)	200970
THORIUM-URANIUM ALLOYS	200970
CAN 610, 322 (1960)	200970
CA 55, 11274 (1961)	200970

RUSIN, A TATEVSKII, V		202125
IM V LOMONOSOV STATE UNIV MOSCOW	RUSSIA)	202125
HEAT OF FORMATION OF THE B02 RADICAL		202125
ZH FIZ KHIM 37, 716 (1963)		202125
CA 59, 7027 (1963)		202125
RUSIN, A TATEVSKII, V		301117
THE NATURE OF THE GREEN LIGHT AND THE COMPOSITION OF THE		301117
PRODUCTS IN THE COMBUSTION OF BORON AT A TEMPERATURE OF 3100K		301117
DOK AKAD NAUK SSSR 139, 630 (1961)		301117
COTS 54, 288 (1962)		301117
RUSSELL, V HIRST, R KANDA, F KING, A		300968
(SYRACUSE UNIV SYRACUSE	NEW YORK)	300968
AN X-RAY STUDY OF THE MAGNESIUM BORIDES		300968
ACTA CRYST 6, 870 (1953)		300968
CA 48, 1800 (1954)		300968
RUSSELL, H		400540
(PRINCETON UNIV PRINCETON	N J)	400540
THE ARC AND SPARK SPECTRA OF GADOLINIUM		400540
J OPTICAL SOC AM 40, 550 (1950)		400540
CA 44, 10497 (1950)		400540
RUZINOV, L BELOV, S		301568
THERMODYNAMICS OF ZIRCONIUM + HAFNIUM CHLORIDES		301568
AD 267737		301568
RYABCHIKOV, D GOLBRAYKH, Y		700656
THORIUM AND ITS COMPOUNDS		700656
USPEKHI KHIM 28, 408 (1959)		700656
GR 36, NO 1, 17 (1961)		700656
RYABCHIKOV, I V MIKULINSKII, A S		301336
THE THERMODYNAMICS OF REDUCTION OF CALCIUM AND MAGNESIUM		301336
OXIDES BY SILICON		301336
ZHUR, PRIKLAD KHIMII 35, 1656 (1962)		301336
COTS 66, 322 (1963)		301336
RYABCHIKOV, I V MIKULINSKII, A S		301337
REDUCTION OF MAGNESIUM OXIDE WITH SILICON DURING SMELTING		301337
OF MAGNESIUM ALLOYS		301337
IZV AKAD NAUK SSSR, OTD TEKH NAUK MET I GORN DEL0 1963,		301337
NO 2, 9 (1963)		301337
CA 59, 1337B (1963)		301337
RYABCHIKOV, D SKLYARENKO, Y		200787
RARE EARTH ELEMENTS AND THE POSSIBILITY OF THEIR PRODUCTION		200787
REDKIE METALLY I SPLAVY, TRUDY Pervogo Vsesoyuz Sovesh-		200787
CHANYIA PO SPLAVAM REDKIKH METAL AKAR NAUK SSSR INST MET		200787
IM A A BAIKOVA, MOSCOW 2957, 171 (1960)		200787
CA 55, 195 (1961)		200787
RYABCHIKOV, L TIKHINSKII, G		200974
MASS-SPECTROMETRIC STUDY OF BERYLLIUM CHLORIDE SUBLIMATION		200974
FIZ METAL I METALLOVED AKAD NAUK SSSR 10, 635 (1960)		200974
CA 55, 11928 (1961)		200974
RYBALCHENKO, R TRETYAKOV, V CHAPOROVA, I		300346
EFFECT OF TANTALUM CARBIDE ON THE COMPOSITION AND PROPERTIES		300346
OF COBALT PHASE IN TITANIUM CARBIDE-TUNGSTEN CARBIDE-COBALT		300346
ALLOYS		300346
IZ AK NAUK SSSR OTDEL TEKH NAUK, METAL I TOPLIVO 4,83 (1961)		300346

COTS 47,103 (1961)	300346
RYSHKEWITCH, E	301338
NEW ERA OF CERAMICS	301338
TRANS NEW YORK ACADEMY OF SCIENCES 25, 827 (1963)	301338
SABA, W WALLACE, W	201268
(UNIV OF PITTSBURGH PITTSBURGH PENNA)	201268
HEAT CAPACITIES OF DYCOS IN RELATION TO ITS MAGNETIC	201268
ANOMALY, THIRD-LAW ENTROPIES, AND RELATED THERMO-CHEMICAL	201268
DATA	201268
J CHEM PHYS 35, 689 (1961)	201268
CA 56, 2955 (1962)	201268
SABA, W WALLACE, W SANDMO, H CRAIG, R	300810
(UNIV OF PITTSBURGH PITTSBURGH PA)	300810
HEAT CAPACITIES AND THE RESIDUAL ENTROPY OF TA2H	300810
J CHEM PHYS 35, 2148 (1961)	300810
PA 65, 2054 (1962)	300810
SACHS, F	201059
RARE EARTH AND MONAZITE SANDS-LIST OF SELECTED REFERENCES TO	201059
TECHNICAL REPORTS, BOOKS, AND JOURNALS	201059
US AT ENERGY COMM TID-4900 (1961)	201059
CA 55, 16239 (1961)	201059
SADOVSKII, V BOGACHEVA, G SMIRNOV, L SOROKIN, I	600863
KOMPANEITSEV, N	600863
AN INVESTIGATION OF RECRYSTALLIZATION IN TITANIUM	600863
FIZ MET I METALLOVED 10, 397 (1960)	600863
PA 64, 10227 (1961)	600863
SAEKI, Y OMORI, G	301339
CHLORINATION OF TANTALUM CARBIDE AND NIOBIUM CARBIDE	301339
DENK. KAGAKN 31, 410 (1963)	301339
SAKELLARIDIS, P	100184
ENERGY LEVELS AND WEAK EMISSIONS OF THE ELEMENTS THALIUM,	100184
HOLMIUM, TERBIUM, GADOLINIUM, AND EUROPIUM	100184
COMPT REND 236, 1767 (1953)	100184
CA 47, 10994 (1953)	100184
SAKELLARIDIS, P	600926
CHARACTERISTIC MULTIPLETS OF RARE EARTHS IN THEIR	600926
X-EMISSION SPECTRA	600926
J PHYS RADIUM 16, 442 (1955)	600926
CA 49, 1212 (1955)	600926
SAKELLARIDIS, P	600979
EMISSIONS IN THE NEIGHBORHOOD OF ABSORPTION DISCONTINUITIES	600979
IN THE L REGION OF THE X-RAY SPECTRA OF THE RARE EARTHS	600979
J PHYS RADIUM 16, 271 (1955)	600979
CA 49, 12123 (1955)	600979
SALTER, L	300986
VAPOR PRESSURE OF A MONATOMIC CRYSTAL	300986
TRANS FAR SOC 59, 657 (1963)	300986
SAMARIN, A	400595
STRUCTURE AND PROPERTIES OF LIQUID METALS	400595
STRUKTURA I SVYSTVA ZHIDKAY METALLOV, AK NAUK	400595
SSSR, INST METALLURGII IMENI A A BAIKOVA (1960)	400595

SAMØILØV, Ø	300539
STRUCTURE OF LIQUID METALS	300539
IZV AKAD NAUK SSSR ØTD TEKH NAUK MET I TØPLIVØ NØ 3, 116	300539
(1961)	300539
BHT NØ 2, 34 (1962)	300539
SAMØKHVALØV, A RUSTAMØV, A	301567
ELECTRIC AND MAGNETIC PROPERTIES OF TIØ	301567
FIZ TVERD TELA 5, 1202 (1963)	301567
CA 59, 3391 (1963)	301567
SAMSØNØV, G	300989
THE CHEMISTRY OF SILICIDES OF RARE-EARTH ELEMENTS	300989
USPKHI KHIM 31, NØ 12, 1478 (1962)	300989
SAMSØNØV, G	301342
MELTING COMPOUNDS HANDBOOK ON PROPERTIES AND USES	301342
MØSCØW GØS NAUCHN TEKHN IZD LIT PØ CHERN I TSVETN	301342
MET 1963 398 (1963)	301342
CA 59, 1306 C (1963)	301342
SAMSØNØV, G	201343
THE PHYSICO-CHEMICAL AND MECHANICAL PROPERTIES OF CARBIDES AND	201343
NITRIDES OF BØRØN AND SILICØN	201343
METALLØKERAM MATERIALY I METØDY IKH ISSLEDØVANIYA AKAD NAUK	201343
UKR SSR INFORM MATERIALY (1959) 36	201343
CA 56, 5743 (1962)	201343
SAMSØNØV, G	300273
REACTIONS OF TI, ZR, AND W BØRIDES WITH THEIR CARBIDES	300273
VØPRØSY PØRØSHKØVØI MET I PRØCHNØSTI-MATERIALØV AKAD NAUK	300273
UKR SSSR NØ 7, 72 (1959)	300273
NSA 14, NØ 16, 16031 (1960)	300273
SAMSØNØV, G	400619
SILICIDES AND THEIR USES IN ENGINEERING	400619
SILITSIDY I IKH ISPØLIZØVANIYE V TEKHNIKE (1959)	400619
SAMSØNØV, G	700947
(INST OF METAL CER.+ SPEC AL KIEV RUSSIA)	700947
ELECTRON STRUCTURE AND PROPERTIES OF HIGH-MELTING METAL	700947
NITRIDES	700947
ZHUR STRUKT KHIM 1, 447 (1960)	700947
NSA 15, 22781 (1961)	700947
SAMSØNØV, G V LYUTAYA, M D	301340
PREPARATION OF CERIUM NITRIDE	301340
ZHUR PRIK KHIM 35, 2359(1962) JPRS 18919	301340
CØTS 65, 147 (1963)	301340
SAMSØNØV, G	301571
INTERMEDIATE STAGES OF REACTIONS FORMING CARBIDES OF TITANIUM	301571
ZIRCØNIUM VANADIUM NIØBIUM + TANTALUM	301571
TRANS FRØM ØLS NEØRG I FIG KHIM 287	301571
AD 265797	301571
SAMSØNØV, G KØNSTANTINØV, V	301570
TANTALUM + NIØBIUM	301570
CØNSØLD TRANS SURVEY P208 SEPT (1961)	301570
TRANSL BY FTD MCL-656 LI	301570
SAMSØNØV, G LYUTAYA, M	301572

PREPARATIONS OF CERIUM NITRIDE ZH PRIKL KHIM 35, 2359 (1962) CA 58, 7595 (1963)	301572 301572 301572
SAMSONOV, G THE SILICIDES AND THEIR USES IN TECHNOLOGY IZD AKAD NAUK UKRAIN SSR KIEV (1959) CITED BY GÖLUTVIN RJPC 36, 698 (1962)	202126 202126 202126 202126
SAMSONOV, G PADERNO, Y ELECTRICAL PROPERTIES OF SOME RARE EARTH HEXABORIDES CA 58, 8483 (1963)	202127 202127 202127
SAMSONOV, G FOMENKO, V PADERNO, Y (INST POWER MET + SPEC AL KIEV RUSSIA) THERMOEMISSIVE PROPERTIES OF SOME REFRACTORY COMPOUNDS UPR FIZ ZH 8, (6) 700 (1963) CA 59, 8228 (1963)	202128 202128 202128 202128 202128
SAMSONOV, G VERKHÖGLYADOVA, T THE HARDNESS OF SOME METAL NITRIDES ZH STRUKT KHIM 2, 617 (1961) CA 58, 5335 (1963)	301573 301573 301573 301573
SAMSONOV, G VERKHÖGLYADOVA, T (ACAD SCI UKRAÏNIA SSR) NITRIDING OF NIOBIUM POWDER AND SOME PROPERTIES OF THE PHASES FORMED RUSS J INORG CHEM 6, 1381 (1961)	301569 301569 301569 301569 301569
SAMSONOV, G PENKOVSKI, V STUDY OF THE EMISSIVE POWER OF CERTAIN HIGH MELTING COMPOUNDS IN THE INFRARED REGION OPTICS AND SPECTROSCOPY 11, 219 (1961) PA 65, 7453 (1962)	300800 300800 300800 300800 300800
SAMSONOV, G SLEPTSOV, V PRELIMINARY VARIATION OF THE DIAGRAM OF THE BORON-SILICON SYSTEM DOPÖVIDI AKAD NAUK UKR RSR 1962, 1066 (1962) CA 58, 60E (1963).	301341 301341 301341 301341 301341
SAMSONOV, G VERKHÖGLYADOVA, T THE PHYSICAL PROPERTIES OF TRANSITION METAL NITRIDES DOKL AKAD NAUK SSSR 142, 608 (1962) CA 56, 15267 (1962)	300997 300997 300997 300997
SAMSONOV, G VERKHÖGLYADOVA, T THE PHYSICAL PROPERTIES OF TITANIUM NITRIDE IN THE HOMOGENEOUS REGION DOKLADY AKAD NAUK SSSR 138, 342 (1961) CA 56, 2898 (1962)	201264 201264 201264 201264 201264
SAMSONOV, G STRASHINSKAYA, L SHILLER, E CONTACT REACTION BETWEEN METALLIC CARBIDES, NITRIDES, AND BORIDES WITH REFRACTORY METALS AT ELEVATED TEMPERATURES IZV AKAD NAUK SSSR ÖTD TEKHN NAUK MET I TOP 1962, NO 5, 167 (1962) CA 58, 1188 (1963)	300990 300990 300990 300990 300990 300990
SAMSONOV, G CARBIDES, SILICIDES, BORIDES, NITRIDES AND SULFIDES OF RARE METALS AND THEIR USE IN NEW TECHNOLOGY	300996 300996 300996

VISNIK AKAD NAUK UKR RSR 30, NO 6, 27 (1959) CA 54, 22243 (1960)	300996 300996
SAMSONOV, G VERKHOGLYADOVA, T (INST MET ACAD SCI UKRANIAN SSR) NITRIDATION OF POWDERED NIOBIUM ZHUR NEORG KHIM 6, 2732 (1961) NSA 16, 8749 (1962)	601576 601576 601576 601576 601576
SAMSONOV, G VERKHOGLYADOVA, T LVOV, S NEMCHENKO, V (N K KRUPSKAYA PEDAGOG INST KHERSON) THE INFLUENCE OF OXYGEN ON THE ELECTRIC PROPERTIES OF TITANIUM NITRIDE DOKL AKAD NAUK SSSR 142, 862 (1962) CA 57, 2957 (1962)	300731 300731 300731 300731 300731 300731
SAMSONOV, G (INST MET ACAD SCI UKRANIAN SSR) THERMO PHYSICAL PROPERTIES OF ALLOYS IN SYSTEMS OF BORON-NITROGEN, BORON-CARBON, SILICON-NITROGEN AND BORON-SILICON-CARBON POROSHKOVAYA MET NO 3, 53 (1961) NSA 16, 3506 (1962)	601585 601585 601585 601585 601585 601585
SAMSONOV, G PREPARATION AND PROPERTIES OF SCANDIUM DIBORIDE DOKLADY AKAD NAUK SSSR 133, 1344 (1960) CA 55, 12127 (1961)	700728 700728 700728 700728
SAMSONOV, G (KALININ INST LENINGRAD USSR) ELECTRIC CONDUCTIVITY OF SOME COMPOUNDS OF THE TRANSITION METALS WITH BORON, CARBON, NITROGEN, AND THEIR MELTS ZHUR TEKH FIZ 26, 716 (1956) CA 50, 14282 (1956)	700730 700730 700730 700730 700730 700730
SAMSONOV, G BORIDES OF THE RARE EARTH METALS USPEKHI KHIM 28, 189 (1959) AND AERE-TRANS-849 CA 53, 11074 (1959) NSA 13, 10103 (1959) NSA 14, 16001 (1960) (TRANSLATION)	700845 700845 700845 700845 700845 700845
SAMSONOV, G GRODSSTEIN, A (KALININ INST LENINGRAD USSR) SOME PROPERTIES OF HEXABORIDES OF ALKALI AND RARE EARTH METALS ZHUR FIZ KHIM 30, 379 (1956) NSA 10, 9210 (1956)	601255 601255 601255 601255 601255
SAMSONOV, G ANALYSIS OF REFRACTORY COMPOUNDS FTD-TT-62-1618 METALL, MOSCOW, 1-256 (1962) COTS NO 59, 154 (1962)	300981 300981 300981 300981 300981
SAMSONOV, G INTERACTION OF TITANIUM, ZIRCONIUM AND TUNGSTEN BORIDES WITH THEIR CARBIDES VOPROSY POROSHKOVOI MET I PROCHNOSTI MATERIALOV, AKAD NAUK UKR SSR 7, 72 (1959) CA 55, 14238 (1961)	500120 500120 500120 500120 500120 500120

SAMSONOV, G GRODSHEIN, A	700733
(KALININ INST MOSCOW USSR)	700733
SOME OF THE PROPERTIES OF THE HEXABORIDES OF THE ALKALINE	700733
EARTH AND RARE EARTH METALS	700733
ZHUR FIZ KHIM 30, 379 (1956)	700733
CA 51, 3335 (1957)	700733
SAMSONOV, G IASINSKIYA, G CHILLER, E	300340
REACTION BETWEEN SOME OXIDES AND CARBIDES OF REFRACTORY	300340
METALS AT HIGH TEMPERATURE	300340
OGNEUPORY (7) 335 (1961)	300340
BHT 4, 44 (1961)	300340
SAMSONOV, G KISLYY, P	900200
BORIDE ZIRCONIUM TIPS FOR IMMERSION THERMOCOUPLES	900200
OGNEUPORY 1961, NO 2, 72 (1961)	900200
FTD-TT-62-732	900200
SAMSONOV, G KOVALCHENKO, M	300985
SOME FEATURES OF THE SINTERING OF POWDERS OF REFRACTORY	300985
COMPOUNDS	300985
POROSHKOVAYA METALL NO 1, 20 (1961)	300985
COTS NO 60, 82 (1962)	300985
SAMSONOV, G KOSOLAPOVA, T	300555
REACTION OF CHROMIUM OXIDE AND CARBIDE WITH THE	300555
FORMATION OF METALLIC CR	300555
ZH PRIKL KHIM 34, NO 12, 2780 (1961)	300555
BHT NO 2, 52 (1962)	300555
SAMSONOV, G KOSOLAPOVA, T MAKARENKO, G	700743
PREPARATION AND SOME PHYSICOCHEMICAL PROPERTIES OF YTTRIUM	700743
CARBIDES	700743
ZH NEORG KHIM 7, 975 (1962)	700743
SAMSONOV, G KOSOLAPOVA, T PADERNO, V	700376
PREPARATION OF THORIUM CARBIDES	700376
ZHUR PRIKL KHIM 33, 1661 (1960)	700376
SST 4, 7, 3 (1960)	700376
SAMSONOV, G KOVALCHENKO, M	900221
A METHOD OF OBTAINING BORON NITRIDE	900221
FTD-TT-63-65	900221
SAMSONOV, G PADERNO, V	201143
PREPARATION AND SOME PROPERTIES OF HAFNIUM CARBIDE	201143
ZHUR PRIKLAD KHIM 34, 963 (1961)	201143
CA 55, 20744 (1961)	201143
SAMSONOV, G MAKARENKO, G KOSOLAPOVA, T	700811
PREPARATION AND PROPERTIES OF YTTRIUM MONOCARBIDE	700811
ZHUR PRIKLAD KHIM 34, 1444 (1961)	700811
NUCL SCI ABST 15, 27985 (1961)	700811
SAMSONOV, G MAKARENKO, G KOSOLAPOVA, T	700744
SCANDIUM CARBIDES AND COMPOUND SC-TI CARBIDES	700744
DOKLADY AKAU NAUK SSSR 144, 1062 (1962)	700744
NSA 16, 29 400 (1962)	700744
SAMSONOV, G MARKOVSKIY, L ZHIGACH, A	301118
BORON ITS COMPOUNDS AND ALLOYS	301118
UKRAINIAN BK BORON YEGO SOEDINENIYA I SPLAVY (1960)	301118

SAMSONOV, G NESHFOR, V	700734
SOME PHYSICAL PROPERTIES OF CERMETS	700734
VOPROSY POROSHKOVOI MET I PROCHNOSTI MATERIALOV, AKAD NAUK UKR	700734
SSSR, NO 5 3 (1958)	700734
CA 50, 9259 (1956)	700734
CA 51, 17403 (1957)	700734
CA 53, 6950 (1959)	700734
 SAMSONOV, G NESHFOR, V	201052
THERMO-EMISSION OF THE TRANSITION METALS IN THEIR COMPOUNDS	201052
WITH BORON, CARBON, NITROGEN, AND SILICON	201052
VOPROSY POROSHKOVOI MET I PROCHNOSTI MATERIALOV AKAD NAUK UKR	201052
SSR 1959, NO 7, 99 (1959)	201052
CA 55, 16154 (1961)	201052
 SAMSONOV, G PADERNO, Y	300317
BORIDES OF RARE EARTH METALS	300317
KIEV IZDATL AKAD NAUK UKR SSR (1961)	300317
 SAMSONOV, G PADERNO, Y	300143
ELECTRIC PROPERTIES OF BORIDES OF RARE-EARTH METALS	300143
DOPVIDI AKAD NAUK UKR. RSR 1215 (1959)	300143
CA 55, 6329 (1961)	300143
 SAMSONOV, G PADERNO, Y FOMENKO, V	601382
PREPARATION AND PROPERTIES OF NEODYMIUM BORIDES	601382
VOPROSY POROSHKOVOI MET I PROCHNOSTI	601382
MATERIALOV, AKAD NAUK UKR SSR NO 8 66 (1960)	601382
NSA 15, 5063 (1961)	601382
 SAMSONOV, G PADERNO, Y KREINGOLD, S	700862
(ACADEMY OF SCIENCES MOSCOW USSR)	700862
PREPARATION OF LANTHANUM HEXABORIDE	700862
ZHUR PRIKLAD KHIM 34, 10 (1961)	700862
NUC SCI ABSTR 15, 14289 (1961)	700862
 SAMSONOV, G PADERNO, Y SEREBRYAKOVA, T	201621
BORIDES OF PRASEODYMIUM, ERBIUM, AND TERBIUM	201621
KRISTALLOGRAFIYA 4, 542 (1959)	201621
CA 57, 2952 (1962)	201621
 SAMSONOV, G PORTNOY, K	900206
ALLOYS BASED ON HIGH-MELTING COMPOUNDS	900206
SPLAVY NA OSNOVE TUGOPLAVKIKH SOEDINENIY (1961)	900206
FTD-TT-62-430	900206
 SAMSONOV, G SEMENOV, U BORODULIN, P	300582
BORON NITRIDE REFRACTORY MATERIAL	300582
OGNEUPORY 27, NO 7, 332 (1962)	300582
CT NO 17, 93 (1962)	300582
 SAMSONOV, G SEREBRYAKOVA, T BOLGAR, A	601581
(INST MET ACAD SCI UKRAINIAN SSR)	601581
PREPARATION AND PHYSICO-CHEMICAL PROPERTIES OF STRONTIUM	601581
HEXABORIDE	601581
ZHUR NEORG KHIM 6, 2243 (1961)	601581
NSA 16, 6758 (1962)	601581
 SAMSONOV, G SHULISHOVA, O	300756
CALCULATION OF ENERGY OF CRYSTAL LATTICES OF METALLIC	300756
COMPOUNDS	300756
IZV AKAD NAUK SSSR, OTD TEKH NAUK MET I TOPLIVO	300756
1962, NO 3, 51 (1962)	300756

CT NO 16, 89 (1962)	300756
SAMSØNØV, G SØLNNIKØVA, L PØRTNØI, K	200894
ALLØYS IN THE SYSTEM B-SI-C	200894
ZHUR NEØRG KHIM 5, 2032 (1960)	200894
CA 55, 6329 (1961)	200894
SAMSØNØV, G SYNELNYKØVA, V	300385
WIDTH ØF THE FØRBIDDEN ZØNE IN BØRØN CARBIDE	300385
UKR FIZ ZHUR 6, NO 5 687 (1961)	300385
RUSS ACC 14, NO 11 2914 (1962)	300385
SAMSØNØV, G UMANSKII, Y	201726
(NATL AERØN, SPACE ADMIN)	201726
HARD CØMPØUNDS ØF REFRACTØRY METALS	201726
TECH TRANSL F102, (1962)	201726
CA 57, 5599 (1962)	201726
SAMSØNØV, G VAINSHTEIN, E PADERNØ, U	300628
RESULTS ØN ELECTRØPHYSICAL AND X-RAY DIFFRACTION STUDIES	300628
ØF THE HEXABØRIDES ØF RARE EARTH ELEMENTS	300628
FIZ METAL I METALLØVED 13, 744 (1962)	300628
SAMSØNØV, G VERKHØGLYADØVA, T ANTØNØVA, M DUBØVIK, T	201280
PREPARATION ØF NITRIDES ØF REFRACTØRY METALS	201280
METALLØKERAM MATERIALY I METØDY IKH ISSLEDØVANIYA AKAD NAUK	201280
UKR SSR INFØRM MATERIALY 1959, 53	201280
CA 56, 3230 (1962)	201280
SAMSØNØV, G YASINSKAYA, G SHILLER, E	100180
THE REACTION ØF CERTAIN ØXIDES AND CARBIDES WITH REFRACTØRY	100180
METALS AT HIGH TEMPERATURES	100180
ØGNEUPØRY 7, 335 (1961)	100180
CØTS 48, 269 (1961)	100180
SAMSØNØV, G ZHURAVLEV, N	600788
STRUCTURE AND PRØPØRTIES ØF RARE EARTH METAL BØRIDES	600788
TRUDY SEMINARA PØ ZHARØSTØIKIM MATERIALAM AKAD NAUK UKR.	600788
SSR- INST METALLØKERAM I SPETSIAL SPLAVØV, KIEV 1958,	600788
NO 5 43 (1960)	600788
CA 55, 14003 (1961)	600788
SAMSØNØV, G ZØRINA, Ø	601051
(MI KALININ INST MOSCØW RUSSIA)	601051
PREPARATION AND PRØPØRTIES ØF THØRIUM HEXABØRIDE	601051
ZHUR NEØRG KHIM 1, 2260 (1956)	601051
CA 51, 8565 (1957)	601051
SAMSØNØV, G ZHURAVLEV, N PADERNØ, Y MELIK-ADAMYAN, V	201758
SYNTHESIS AND STRUCTURE ØF SAMARIUM HEXABØRIDE	201758
KRISTALLØGRAFIYA 44, 538 (1959)	201758
CA 57, 6849 (1962)	201758
SAMSØNØV, G SLEPTSØV, V	201815
KINETIC PARAMETERS ØF BØRØN NITRIDATION	201815
KINETIKA I KATALIZ AKAD NAUK SSSR SB STATAI 3129 (1960)	201815
CA 57, 10562 (1962)	201815
SAMSØNØV, G SINELNIKØVA, V	201968
ELECTRICAL RESISTANCE ØF REFRACTØRY CØMPØUNDS AT HIGH	201968
TEMPERATURES	201968
PØRØSHKØVAYA MET AKAD NUAUK UKR SSR 2 NO 4 59 (1962)	201968
CA 58, 1000 (1963)	201968

SAMSONOV, G KOVALCHENKO, M	301154
HOT PRESSING TECHNOLOGY IN THE SOVIET MACHINE BUILDING AND	301154
METALLURGICAL INDUSTRIES	301154
RUSSIAN BK GORYACHEYE PRESSOVANIYE KIEV 1962	301154
COTS 63, 132 (1963)	301154
SANCHO, F	601091
(UNIV MADRID MADRID SPAIN)	601091
STRUCTURE OF THE SPECTRUM OF RHODIUM 11	601091
ANALFS REAL SOC ESPAN FIS Y QUIM (MADRID)	601091
SER A, 54A, 41 (1958)	601091
CA 52, 10711 (1958)	601091
SANCHO, F	601092
(UNIV MADRID MADRID SPAIN)	601092
DESCRIPTION OF THE SECOND SPECTRUM OF RHODIUM (RH11)	601092
ANALES REAL SOC ESPAN FIS Y QUIM (MADRID) SER. A 54A, 65	601092
(1958)	601092
CA 52, 10711 (1958)	601092
SAND, T IMOTO, S TAKADA, Y	200963
(UNIV OSAKA OSAKA JAPAN)	200963
PRODUCTION OF URANIUM CARBIDE. II. REACTION BETWEEN URANIUM	200963
POWDER AND SOME HYDROCARBONS	200963
NIPPON GENSIRYOKU GAKKAISHI 2, 285 (1960)	200963
CA 55, 11161 (1961)	200963
SANDERSON, B MACWOOD, G	300291
(OHIO STATE UNIV COLUMBUS OHIO)	300291
THERMODYNAMICS OF THE TITANIUM CHLORIDES. III. THE SUBLIMA-	300291
TION PRESSURE OF TITANIUM TRICHLORIDE	300291
J PHY CHEM 60, 314 (1956)	300291
SANDERSON, L	300375
THORIUM	300375
CAN MINING J 82, NO 6 84 (1961)	300375
BHT NO 1, 9 (1962)	300375
SANDERSON, L	300376
SCANDIUM	300376
CAN MINING J 82, NO 7 60 (1961)	300376
BHT NO 1, 9 (1962)	300376
SANDERSON, L	300377
RHODIUM	300377
CAN MINING J 82, NO 11 65 (1961)	300377
BHT NO 1, 9 (1962)	300377
SANDS, D CLINE, C ZALKIN, A HOENIG, C	700556
(UNIV OF CALIF LIVERMORE CALIF)	700556
BERYLLIUM-BORON SYSTEM	700556
ACTA CRYST 14, 309 (1961)	700556
UCRL-6035-T	700556
NS 15, 13379 (1961)	700556
SANDS, D JOHNSON, O ZALKIN, A KRIKORIAN, O KROMHOLTZ, K	201879
THE CRYSTAL STRUCTURE OF REBF22	201879
ACTA CRYST 15, 832 (1962)	201879
CA 57, 13248 (1962)	201879
SANO, K	300983
DISSOCIATION EQUILIBRIA OF CHROMIUM NITRIDES	300983

AEC TR-5388	300983
JOURNAL OF THE CHEMICAL SOC OF JAPAN 58, NO 10, 981 (1955)	300983
COTS NO 60, 91 (1962)	300983
SARA, R DOLLÖFF, R	601622
(NAT CARBON CO PARMA OHIO)	601622
RESEARCH STUDY TO DETERMINE THE PHASE EQUILIBRIUM RELATIONS	601622
OF SELECTED METAL CARBIDES AT HIGH TEMPERATURE	601622
WADD-TR-60-143 (PT III) (1962)	601622
NSA 16, 24798 (1962)	601622
SARÖ, T IMÖTÖ, S TAKADA, Y	400591
RESEARCH ON THE PRODUCTION OF URANIUM MONOCARBIDE	400591
NIPPON GENSIRYÖKU GAKKAISHI 1, 425 (1959)	400591
SATÖ, S	900114
ATOMIC HEAT OF NITROGEN IN VARIOUS NITRIDES. II.	900114
SCI PAPERS INST PHYS CHEM RESEARCH (TÖKYÖ) 35, 385 (1939)	900114
CA 33, 7163 (1939)	900114
SATÖ, T KACHI, S IWASE, K	300268
(TÖHÖKU UNIV SENDAI JAPAN)	300268
THERMODYNAMIC ACTIVITIES IN IRÖN-CÖBALT ALLOYS	300268
NIPPÖN KINZÖKU GAKKAISHI 20, 584 (1956)	300268
CA 54, 17208 (1960)	300268
SATÖMA, K	201025
(TÖKYÖ INST TECHNÖL TÖKYÖ JAPAN)	201025
OXYGEN POSITIONAL PARAMETERS OF TETRAGONAL MN3Ö4	201025
J PHYS SOC JAPAN 16, 258 (1961)	201025
CA 55, 14004 (1961)	201025
SAVAGE, W HUDSON, D SPEDDING, F	601126
(IÖWA STATE COLL. AMES IÖWA)	601126
MASS SPECTROMETRIC STUDY OF HEATS OF SUBLIMATION OF	601126
DYSPROSIUM, SAMARIUM, THULIUM, AND YTTERBIUM	601126
J CHEM PHYS 30, 221 (1959)	601126
CA 53, 10935 (1959)	601126
SAVITSKII, E	201205
RARE EARTH METALS	201205
METALLOVED I TERMICHESE, ÖBRABÖTKA METAL 1961, NO 9, 19	201205
(1961)	201205
CA 56, 245 (1962)	201205
SAVITSKII, E BARÖN, V EFIMÖV, Y	201552
COMPOSITION DIAGRAM OF THE VANADIUM-CERIUM SYSTEM	201552
ZH NEÖRGAN, KHIM 7, 701 (1962)	201552
CA 56, 15127 (1962)	201552
SAVITSKII, E BARÖN, W EFIMÖV, Y	300609
VANADIUM CRYSTALLIZATION DIAGRAM	300609
DÖKLADY AKAD NAUK, 145, NO 3, 612 (1962)	300609
SAVITSKII, E BARÖN, V IVANÖVA, K	201705
FUSABILITY CURVE AND SOME PROPERTIES OF ALLOYS OF THE NIÖBIUM-	201705
MÖLYBDENUM-TUNGSTEN SYSTEM	201705
IZV AKAD NAUK SSR, ÖTD TEKHN NAUK, MET I TÖPLIVÖ 1962,	201705
NO 2, 113 (1962)	201705
CA 57, 4440 (1962)	201705
SAVITSKII, E BARÖN, V IVANÖVA, K	201345
THE RECRYSTALLIZATION OF NIÖBIUM AND ITS ALLOYS	201345

INZHENER-FIZ ZHUR AKAD NAUK BELORUS SSR 1958, NO 11, 38 CA 56, 5744 (1962)	201345 201345
SAVITSKII, E BARON, V EFIMOV, Y GLADYSHEVSKII, E (A A BAIKOV INST MET LVOV POLAND) SYSTEM VANADIUM-MOLYBDENUM-SILICON ZH NEORGAN KHIM 7, 1117 (1962) CA 57, 9278 (1962)	201798 201798 201798 201798 201798
SAVITSKII, E LIVANOV, V NUSS, P BURKHANOV, K MUSATOV, M SIMANCHUK, A ALLOYS OF TITANIUM WITH RARE EARTH METALS TITAN V PROM SB STATEI 85, (1961) CA 57, 13501 (1962)	201889 201889 201889 201889 201889
SAVITSKII, E TYLKINA, M (ACAD SCIENCE MOSCOW RUSSIA) PHASE DIAGRAMS OF RE WITH TRANSITION METALS CA 58, 12246 (1963)	301574 301574 301574 301574
SAVITSKII, E TYLKINA, M POLYAKOVA, V COMPOSITION DIAGRAM OF THE RUTHENIUM-RHENIUM-OSMIUM SYSTEM ZH NEORGAN KHIM 8, 146 (1963) CA 58, 10779 (1963)	301575 301575 301575 301575
SAVITSKII, E TYLKINA, M TSYGANOVA, I GLADYSHEVSKII, E MULYAVA, M (A A BAIKOV INST MET LVOV POLAND) COMPOSITION DIAGRAM OF THE HAFNIUM RHENIUM SYSTEM ZH NEORGAN KHIM 7, 1608 (1962) CA 57, 9277 (1962)	201795 201795 201795 201795 201795 201795
SAVITSKII, E BARON, V KHOTINSKAYA, A COMPOSITION DIAGRAM OF THE SYSTEM Nb-Pd ZHUR NEORG KHIM 6, 2603 (1961) CA 56, 9698 (1962)	201429 201429 201429 201429
SAVITSKII, E BURKHANOV, G PHASE DIAGRAM OF THE TITANIUM-SCANDIUM SYSTEM ZHUR NEORG KHIM 6, 1253 (1961) CT NO 12, (1961)	700622 700622 700622 700622
SAVITSKII, E KOPETSKII, C THE PHASE DIAGRAMS OF THE SYSTEMS MN-ZR AND MN-TI ZHUR NEORG KHIM 5, 2422 (1960) CA 56, 2250 (1962)	201261 201261 201261 201261
SAVITSKII, E KOPETSKII, C STRUCTURAL DIAGRAM OF THE SYSTEM MANGANESE-TANTALUM ZH NEORGAN KHIM 5, 2638 (1960) CA 57, 4436 (1962)	201701 201701 201701 201701
SAVITSKII, E TEREKHOVA, V MICROSTRUCTURE, PHYSICAL, AND MECHANICAL PROPERTIES OF RARE EARTH METALS AND THEIR ALLOYS REDKOEZEMEL ELEMENTY AKAD-NAUK SSSR INST GEOKHIM I ANAL KHIM 1959, 299 (1959) CA 55, 16325 (1961)	201067 201067 201067 201067 201067
SAVITSKII, E TEREKHOVA, V BIRUN, N EQUILIBRIUM DIAGRAM OF THE CHROMIUM-RUTHENIUM SYSTEM ZHUR NEORG KHIM NO 8, 1002 (1961) COTS 56, 416 (1962)	300836 300836 300836 300836

SAVITSKIY, Y TYLKINA, N	900230
THE PHYSICO-CHEMICAL PROPERTIES AND FIELDS OF APPLICATION	900230
OF RHEINIUM AND ITS ALLOYS	900230
RENIY TRUDY VSESOSGUZNOVO SOVESHCANIY PO PROBLEME	900230
RENIYA 26, 108 (1958)	900230
SAVITSKII, E TYLKINA, M KIRILENKO, R KOPETSKII, C	700625
PHASE DIAGRAM OF THE MANGANESE-RHEINIUM SYSTEM	700625
ZHUR NEORG KHIM 6, 1474 (1961)	700625
CT NO 13, (1961)	700625
SAVITSKII, E TYLKINA, M POLYAKOVA, V	201531
COMPOSITION DIAGRAM OF THE SYSTEM RUTHENIUM-RHEINIUM	201531
ZH NEORGAN, KHIM, 7 439 (1962)	201531
CA 56, 13920 (1962)	201531
SAVITSKII, E TYLKINA, M POVAROVA, K	300835
EQUILIBRIUM DIAGRAM OF THE ALUMINUM-RHEINIUM SYSTEM	300835
ZHUR NEORG KHIM NO 8, 1003 (1961)	300835
COTS 56, 416 (1962)	300835
SAVITSKII, E TYLKINA, M SHISHKINA, L	201281
CONSTITUTION DIAGRAM OF THE TUNGSTEN-RHEINIUM SYSTEM AND	201281
PROPERTIES OF THESE ALLOYS	201281
IZVEST AKAD NAUK SSSR OTDEL TEKH NAUK MET I TOPLIVO 1959,	201281
NO 3, 99	201281
CA 56, 3234 (1962)	201281
SAVITSKII, E M TYLKINA, M A ZHDANOVA, L L ZUBKOVA, L A	301344
STARKOV, V N FOKIN, A G PETROVA, L S ARKUSHA, T J	301344
THE PROPERTIES OF RHEINIUM AND ITS ALLOYS WITH TUNGSTEN AND	301344
MOLYBDENUM	301344
ISSLED PO ZHAROPROCHN SPLAVAM AKAD NAUK SSSR,	301344
INST MET 9, 194 (1962)	301344
CA 58, 31 OH (1963)	301344
SAVITSKIN, E TEREKHOVA, V BUROV, I MARKOVA, I NAUMKIN, O	202129
SPOVY REDHOZEMEL NGKH METALLOV	202129
(RARE EARTH ALLOYS)	202129
IZDATIL STVO AKAD NAUK SSSR (1962)	202129
SAVOSTIANOVA, N SHVARTSMAN, L	300204
SOLUBILITY OF VANADIUM CARBIDE IN GAMMA IRON	300204
FIZ MET I METALLOVED 9, NO 4 515 (1960)	300204
SAXER, R	301576
(OHIO STATE UNIV COLUMBUS OHIO)	301576
THE CHEMICAL ACTIVITIES OF IRON AND VANADIUM IN BINARY	301576
IRON-VANADIUM ALLOYS AND THE VAPOR PRESSURES OF PURE COBALT,	301576
IRON, AND VANADIUM	301576
DISS ABST 23, (8), 2859 (1962-1963)	301576
CA 58, 13515 (1963)	301576
SAYASOV, Y IVANOV, G	400593
THEORY OF MOLECULAR DISSOCIATION BY NEUTRONS, DIATOMIC	400593
MOLECULES	400593
RUSSIAN REPORT, CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS,	400593
PROCEEDINGS OF A SYMPOSIUM, 1, 25 (1960)	400593
SAYERS, D CARROLL, P	600597
PROC PHYS SOC LONDON 66A, 577 (1953)	600597
THE WAVE LENGTHS OF NITROGEN FIRST POSITIVE BANDS	600597

(QUEENS UNIV CA 47, 9144 (1953)	BELFAST	IRELAND)	600597 600597
SAZHIN, N KOLCHIN, O SUMAROKOVA, N NI0BIUM OXIDE REDUCTION PROCESSES BY CARBON IZV A N SSSR OTD TEKH NAUK MET I TOPL NO 6 8 (1961) RUSS ACC 14, NO 12 3317 (1962)			300381 300381 300381 300381
SCAIFE, D WYLIE, A (COMMLTH SCI AND IND RES ORG MELBOURNE PREPARATION OF THORIUM CARBIDE AND SOME ASPECTS OF THE HIGH TEMPERATURE DECONTAMINATION OF IRRADIATED REACTOR FUELS AUSTRALIAN ATOMIC ENERGY SYMPOSIUM PAGE 172, (1958) NUCL SCI ABSTR 14, 1207 (1960)		AUSTRALIA)	700863 700863 700863 700863 700863 700863
SCACE, R SLACK, G (G E RES LAB SI-C AND GE-C PHASE DIAGRAM SILICON CARBIDE, PROC CONF, BOSTON 1959, 24 (1960) CA 55, 7018 (1961)	SCHENECTADY	NEW YORK)	200768 200768 200768 200768 200768
SCHAEFER, H HUEESKER, M (UNIV MUNSTER CHEMISTRY OF NI0BIUM AND TANTALUM, XXX. CHEMICAL TRANSPORT REACTIONS.8.THE PREPARATION OF NI0BIUM OXIDES AND THEIR TRANSPORT IN TEMPERATURE GRADIENTS Z ANORG ALLGEM CHEM 317,321 (1962) CA 58,222 (1963)	MUNSTER	GERMANY)	201959 201959 201959 201959 201959 201959
SCHAEFER, H HEITLAND, H (UNIV MUNSTER EQUILIBRIUM MEASUREMENTS IN THE IRIIDIUM-OXYGEN SYSTEM GASEOUS IRIIDIUM TRIOXIDE Z ANORG U ALLGEM CHEM 304, 249 (1960) CA 54, 24078 (1960)		GERMANY)	601160 601160 601160 601160 601160 601160
SCHAEFER, H KAHLENBERG, F (UNIV MUNSTER CHEMISTRY OF NI0BIUM AND TANTALUM XXIII. THE THERMOCHEMISTRY OF THE NI0BIUM CHLORIDES Z ANORG U ALLGEM CHEM 305, 291 (1960) CA 55, 2334 (1961)		GERMANY)	200820 200820 200820 200820 200820 200820
SCHAEFER, H SCHNEIDEREIT, G GERHARDT, W (UNIV MUENSTER CHEMISTRY OF THE PLATINUM METALS Z ANORG ALLGEM CHEM 319, 327 (1963) CA 58, 7586 (1963)	MUENSTER	GERMANY)	301577 301577 301577 301577 301577
SCHAEFER, H FUHR, W (UNIV MUENSTER CHEMICAL TRANSPORT REACTIONS.IX,THE TRANSPORT OF TIN WITH HCL IN SMALL MOLYBDENUM TUBES Z ANORG ALLGEM CHEM 319, 52 (1962) CA 58, 10750 (1963)	MUENSTER	GERMANY)	301578 301578 301578 301578 301578 301578
SCHAEFER, H SIBBING, E GERKEN, R (UNIV MUNSTER CHEMISTRY OF NI0BIUM AND TANTALUM. XXVI. THE OXY-CHLORIDES NB3O7CL, NB0CL2, AND TA0CL2 Z ANORG U ALLGEM CHEM 307, 163 (1960) CA 55, 17330 (1961)	MUNSTER	GERMANY)	201085 201085 201085 201085 201085 201085

SCHAEFER, H	601159
(UNIV MUNSTER	601159
GERMANY)	601159
EQUILIBRIUM MEASUREMENTS IN THE PLATINUM-OXYGEN SYSTEM	601159
GASEOUS PLATINUM DIOXIDE	601159
Z ANORG U ALLGEM CHEM 304, 317 (1960)	601159
CA 54, 24079 (1960)	601159
SCHAFER, K	300133
(UNIVERSITY OF HEIDELBERG	300133
HEIDELBERG	300133
GERMANY)	300133
THE PROPERTIES OF SOLIDS AND INTERMOLECULAR FORCES	300133
ANGEW CHEM 72, 503 (1960)	300133
BHT, 8 (1960)	300133
SCHANER, B	601686
METALLOGRAPHIC DETERMINATION OF THE UO ₂ -U ₄ O ₉ PHASE DIAGRAM	601686
J NUCLEAR MET 2, 110 (1960)	601686
SCHENK, P	400579
THE CLASSIFICATION OF THE LANTHANIDES AND TRANSURANIUM	400579
ELEMENTS IN THE PERIODIC SYSTEM OF THE ELEMENTS	400579
OSTERR CHEM ZTG 50, 52 (1949)	400579
CA 44, 12 (1950)	400579
SCHICK, H	202130
A THERMODYNAMIC ANALYSIS OF THE HIGH TEMPERATURE VAPORIZATION	202130
PROPERTIES OF SILICA	202130
CHEM REV 60, 331 (1960)	202130
CA 54, 20454 (1960)	202130
SCHICK, H ANTHRÖP, D DREIKÖRN, R HANST, P PANISH, M	300994
(AVCO RAD	300994
WILMINGTON	300994
MASS)	300994
THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS	300994
THIRD QUARTERLY PROGRESS REPORT	300994
RAD-SR-63-52 (1963), 200 p.	300994
AD 400329	300994
SCHICK, H ANTHRÖP, D DREIKÖRN, R FEBER, R HANST, P	300995
PANISH, M WARD, C	300995
THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS	300995
SECOND QUARTERLY PROGRESS REPORT (1962), 143 p.	300995
AD 292318	300995
AVCO RAD-SR-62-251	300995
SCHICK, H ANTHRÖP, D DREIKÖRN, R HANST, P PANISH, M	301579
(AVCO RAD	301579
WILMINGTON	301579
MASS)	301579
THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS	301579
RAD-SR-63 -105 (1963), 217 p.	301579
AD409592	301579
SCHICK, H ANTHRÖP, D DREIKÖRN, R HANST, P PANISH, M	301580
(AVCO RAD	301580
WILMINGTON	301580
MASS)	301580
THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS	301580
RAD-SR-63 -183 (1963), 252 p.	301580
AD 418437	301580
SCHISSEL, P TRULSÖN, O	300606
(UNION CARBIDE CORP	300606
CLEVELAND	300606
OHIO)	300606
MASS SPECTROMETRIC STUDY OF THE VAPORIZATION OF THE	300606
TITANIUM-BORON SYSTEM	300606
J PHYS CHEM 66, 1492 (1962)	300606
SCHMIDT, E	200814
EINFÜHRUNG IN DIE TECHNISCHE THERMODYNAMIK ETC	200814
8 ED BERLIN SPRINGER-VERLAG (1960)	200814
CA 55, 2266 (1961)	200814

SCHNEIDER, S J			
DISCREPANCY IN CONVERSION OF EARLY MELTING-POINT TEMPERATURES			301348
J AM CERAM SOC 46, 354 (1963)			301348
			301348
SCHNEIDER, P BUK, F			
(TESLA-VRSOVICE	PRAGUE	CZECH	600988
THE PREPARATION OF RARE EARTH BORIDES AS EMISSIVE MATERIAL			600988
SLABOPROUDY OBZOR 14, 137 (1953)			600988
CA 50, 2275 (1956)			600988
			600988
SCHNEIDER, S			
(NATL BUR STANDARDS	WASHINGTON	DC)	201537
PHASE EQUILIBRIUMS IN SYSTEMS INVOLVING THE RARE EARTH OXIDES,			201537
III THE EU2O3-IN2O3 SYSTEM,			201537
J RESEARCH NATL BUR STAND 65A, 429 (1961)			201537
CA 56, 14981 (1962)			201537
			201537
SCHNEIDER, S J			
(NATL BUREAU OF STANDARDS	WASHINGTON	D C)	202131
COMPILATION OF MELTING POINTS OF METAL OXIDES			202131
CERAMIC BULLETIN 42, 237 (1963)			202131
			202131
SCHNEIDER, S ROTH, R			
PHASE EQUILIBRIA IN SYSTEMS INVOLVING THE RARE EARTH OXIDES			700747
PT I POLYMORPHISM OF THE OXIDES OF THE TRIVALENT RARE EARTH			700747
IONS			700747
J RES NAT BUR STDS 64A, 309 (1960)			700747
NUCL SCI ABSTR 14, 21465 (1960)			700747
			700747
SCHNEIDER, S ROTH, R WARING, J			
SOLID STATE REACTIONS INVOLVING OXIDES OF TRIVALENT			201407
ACTIONS			201407
J RESEARCH NATL BUR STANDARDS 65A, 345 (1961)			201407
CA 56, 9480 (1962)			201407
			201407
SCHNEIDEREITTR, G			
OXIDES OF IRIIDIUM AND RUTHENIUM			301582
NEW VALUES FOR OXYGEN PRESSURES OF FORMATION			301582
PLATINIUMMETALS REVIEW 6, NO 4 137 (1962)			301582
			301582
SCHOB, O NOWOTNY, H BENESOVSKY, F			
(UNIV VIENNA	VIENNA	AUSTRIA)	201547
STRUCTURE DETERMINATIONS OF SOME OF THE PHASES IN THE SYSTEMS			201547
ZR-AL-SI AND HF-AL-SI (ZRAL3(SI), ZRSI(AL), HF(SI,AL), ZR3SI2,			201547
HF3SI2)			201547
MONATSH CHEM 6, 1218 (1961)			201547
CA 56, 15013 (1962)			201547
			201547
SCHRAM, A			
(COMPAGN GEN RADIOLOGIE	PARIS	FRANCE)	301583
VAPORIZATION OF TITANIUM			301583
CA 58, 13536 (1963)			301583
			301583
SCHUCH, A LAQUER, H			
(SCI LAB	LOS ALAMOS	N MEX)	400568
LOW TEMPERATURE THERMAL EXPANSION OF URANIUM			400568
PHYS REV 86, 803 (1952)			400568
CA 46, 8503 (1952)			400568
			400568
SCHUCH, A STURDIVANT, J			
(CALIF INST OF TECHNO.	PASADENA	CALIF)	400518
THE STRUCTURE OF CE AT LIQUID AIR TEMPERATURE			400518
J CHEM PHYS 18, 145 (1950)			400518
			400518

CA 44, 4744 (1950)	400518
SCHULZE, A	900117
TRANSFORMATION POINTS IN METALS	900117
Z METALLKUNDE 22, 308 (1930)	900117
CA 25, 1194 (1931)	900117
SCHUURMANS, P	601290
ON THE ANALYSIS OF SOME COMPLEX SPECTRA (TH AND U)	601290
PHYSICA 12, 589 (1946)	601290
AERE-LIB/TRANS 513	601290
NSA 11, 205 (1957)	601290
SCHWARZSCHILD, M SCHWARZSCHILD, B SEARLE, L MELTZER, A	601047
(PRINCETON UNIV OBSERV PRINCETON NJ)	601047
A SPECTROSCOPIC COMPARISON BETWEEN HIGH AND LOW VELOCITY K	601047
GIANTS	601047
ASTROPHYS J 125, 123 (1957)	601047
CA 51, 6350 (1957)	601047
SCLAR, C CARRISON, L SCHWARTZ, C	301584
(BATTELLE MEMORIAL INST COLUMBUS OHIO)	301584
OPTICAL CRYSTALLOGRAPHY OF COESITE	301584
AM MINERALOGIST 47, 1292 (1962)	301584
CA 58, 5116 (1963)	301584
SCLAR, C CARRISON, L SCHWARTZ, C	301585
(BATTELLE MEMORIAL INST COLUMBUS OHIO)	301585
RELATION OF INFRARED SPECTRA TO COORDINATION IN QUARTZ AND	301585
TWO HIGH-PRESSURE POLYMORPHS OF SiO2	301585
SCIENCE 138, 525 (1962)	301585
CA 58, 2029 (1963)	301585
SCLAR, N	300682
(NUCLEAR CORP OF AMERICA DENVER NJ)	300682
UNIJUNCTION DEVICES MADE FROM RARE EARTH SEMICONDUCTORS	300682
AD 274 744 (1961)	300682
SCOTT, R	601115
(ATOMIC ENERGY RES. ESTAB. HARWELL ENGLAND)	601115
THERMAL CONDUCTIVITY OF UO2	601115
ATOMIC ENERGY RESEARCH ESTAB M/R 2526, (1958)	601115
CA 53, 41 (1959)	601115
SDAR, N	300233
(NUCLEAR CORP OF AMERICA DENVER NEW JERSEY)	300233
UNIJUNCTION DEVICES MADE FROM RARE EARTH SEMICONDUCTORS	300233
AD 257796	300233
QUART REPT NO 1 (1961) CONTRACT DA36-039-SC-87392	300233
PROJ 3A99021-001	300233
SEABAUGH, P	201228
(IOWA STATE UNIV AMES IOWA)	201228
PHYSICAL PROPERTIES OF NIOBIUM IODIDES	201228
UNIV MICROFILMS (ANN ARBOR MICH) ORDER NO 61-3049	201228
DISSERTATION ABSTR 22, 731 (1961)	201228
CA 56, 1122 (1962)	201228
SEARCY, A FINNIE, L	201874
(UNIV OF CALIF BERKELEY CAL)	201874
STABILITY OF SOLID PHASES IN THE TERNARY SYSTEMS OF SILICON	201874
AND CARBON WITH RHENIUM AND THE SIX PLATINUM METALS	201874
J AM CERAM SOC 45, 268 (1962)	201874

CA 57, 13219 (1962)	201874
SEARCY, A SCHULZ, D	
(UNIV OF CALIF BERKLEY CALIF)	300980
DEMONSTRATION OF SOME UNRECOGNIZED CHARACTERISTICS	300980
OF GAS FLOW THROUGH ORIFICES	300980
J CHEM PHYS 38, 772 (1963)	300980
SEARCY, A WILLIAMS, W SCHISSEL, P	300590
USE OF CONSTANT BOILING SYSTEMS IN CALIBRATION OF MASS	300590
SPECTROMETERS AND OTHER MOLECULAR BEAM INSTRUMENTS	300590
J CHEM PHYS 32, 957 (1960)	300590
SEDDON, B	
URANIUM CERAMICS DATA MANUAL, PROPERTIES OF	601380
INTEREST IN REACTOR DESIGN	601380
DEG REPORT 120, (1960)	601380
NSA 15, 4280 (1961)	601380
SEEBOLD, R BIRKS, L	
(U S NAVAL RES LAB WASHINGTON D C)	300295
ELEVATED TEMPERATURE DIFFUSION IN THE SYSTEMS NB-PT, NB-SE,	300295
NB-ZN, NB-CO, NI-TA, AND FE-MO	300295
J NUCLEAR MATLS 3, 260 (1961)	300295
CA 55, 19684 (1961)	300295
SEEGER, A	
(MAX-PLANCK-INST STUTTGART GERMANY)	301586
RECENT ADVANCES IN THE THEORY OF DEFECTS IN CRYSTALS	301586
PHYS STATUS SOLIDI 1, 669 (1961)	301586
CA 58, 7442 (1963)	301586
SELL, H KEITH, G KOO, R SCHNITZEL, R CORTH, R	201860
PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN BASE ALLOYS	201860
U S DEPT COM OFFICE TECH SERV A D RLPT 266, 330, 143 (1961)	201860
CA 57, 12210 (1962)	201860
SEMENCHENKO, V K	
CERTAIN EQUILIBRIUM AND NONEQUILIBRIUM PROPERTIES OF QUARTZ	301349
NEAR THE ALPHA TO BETA TRANSITION	301349
PRIMENENIE UL TRAAKUSTIKI K ISSLED VESCHESTVA (15), 11 (1961)	301349
CA 59, 2236E (1963)	301349
SEMENCHENKOV, A IVANOV, O	201894
STRUCTURE OF URANIUM ZIRCONIUM TITANIUM ALLOYS	201894
TR INST MET IM A A BAIKOVA (STRONIE SPLAVOV NEKOTORYKH	201894
SISTEM S URANOM I TORIEM) 312, (1961)	201894
CA 57, 13503 (1962)	201894
SEMENENKO, K KURDYUMOV, G GORDEEV, I	300838
HEATS OF SUBLIMATION OF BERYLLIUM OXIDE SALTS	300838
ZHUR NEORG KHIM NO 9, 1036 (1961)	300838
COTS 56, 417 (1962)	300838
SEMENOV, I KOLBIN, N	201486
ANHYDROUS OSMIUM TETRABROMIDE	201486
ZH NEORGAN, KHIM 7, 219 (1962)	201486
CA 56, 12522 (1962)	201486
SEMIKIN, I KOSTOGRYZOV, V	900223
A HEAT RADIATION CALORIMETER	900223
AVTOMATIZATSIYA I PRIBOROSTROYENIYE	900223
INSTITUT AVTOMATIKI, UKSSR NO 2, 153 (1961)	900223

FTD-TT-63-64	700223
SENATEUR, J FRUCHART, R MICHEL, A	201957
(FAC SCI ORSAY FRANCE)	201957
FORMULA AND CRYSTALLINE STRUCTURE OF HAEGGS CARBIDE	201957
COMPT REND 225, 1615 (1962)	201957
CA 58, 92 (1963)	201957
SENDEROFF, S MELLORS, G BRETZ, R	200930
(UNION CARBIDE CORP PARMA OHIO)	200930
THERMODYNAMIC PROPERTIES OF MOLTEN MIXTURES OF CERIUM	200930
CHLORIDE AND CALCIUM CHLORIDE	200930
J ELECTROCHEM SOC 108, 93 (1961)	200930
CA 55, 9026 (1961)	200930
SENSE, K	201588
(NORTH AM AVIATION INC CANOGA PARK CALIF)	201588
OXIDATION OF ZIRCONIUM	201588
J ELECTROCHEM SOC 109, 377 (1962)	201588
CA 57, 557 (1962)	201588
SEREBRENIKOV, N GELD, P	300192
HEAT CONTENT AND HEAT CAPACITY OF TITANIUM AT HIGH TEMPERATURE	300192
IZVEST VYSSHIKH UCHEB ZAVEDENII TSIVETNAYA MET 4, NO 4 80	300192
(1961)	300192
CT 20, 109	300192
SEREBRENNIKOV, V SEREBRENNIKOV, I	601131
(UCHENYE ZAPISKI TOMSK UNIV)	601131
THERMOCHEMICAL CHARACTERISTICS OF ACTINIDES	601131
REFERAT ZHUR KHIM 14629, (1957)	601131
CA 53, 12818 (1957)	601131
SEREBRYAKOVA, T PADERNO, Y SAMSONOV, G	300136
EMISSION COEFFICIENTS OF SOME POWDERED HIGH-MELTING COMPOUNDS	300136
OPTIKA I SPEKTOSKOPIYA 8, 410 (1960)	300136
BHT, 3 (1960)	300136
SEREBRYANSKII, V EPELBAUM, V	300840
PHASE DIAGRAM OF THE ALUMINUM-BORON SYSTEM	300840
ZHUR STRUK KHIM 2, NO 6, 748 (1961)	300840
COTS 56, 428 (1962)	300840
SERGEEV, V	400604
THE CALCULATION OF THERMODYNAMIC FUNCTIONS OF A	400604
HIGH-TEMPERATURE AIR/CARBON MIXTURE	400604
INZHENERNO-FIZ ZHUR 4, 16 (1961)	400604
SERGEEV, V	500125
THERMODYNAMICS OF REACTIONS OF TITANIUM TETRACHLORIDE	500125
WITH SEVERAL METALS	500125
TSIVETNYE METAL 29, NO 11, 63 (1956)	500125
CA 51, 17674 (1957)	500125
SETTLE, J FEDER, H HUBBARD, W	300740
(ARGONNE NATL LAB ARGONNE ILL)	300740
FLUORINE BOMB CALORIMETRY II. THE HEAT OF FORMATION OF	300740
MOLYBDENUM HEXAFLUORIDE	300740
J PHYS CHEM 65, 1337 (1961)	300740
CA 55, 25448 (1961)	300740
SEYBOLT, A	601484
(KNOLLS AT POWER LAB SCHENECTADY NY)	601484

VANADIUM AS A POSSIBLE STRUCTURAL MATERIAL IN NUCLEAR REACTORS			601484
TID-2501, 441 (1948)			601484
NSA 12, 17303 (1958)			601484
SEYBOLT, A V			
(GE RESEARCH LAB	SCHENECTADY	N Y)	301350
OXIDATION OF METALS			301350
ADVANCES IN PHYSICS 11, NO 45 1 JAN (1963)			301350
SHADMI, Y			
(HEBREW UNIV	JERUSALUM	ISRAEL)	700954
THE CONFIGURATIONS (4D+5S) TO THE NTH POWER IN THE SECOND			700954
SPECTRA OF THE PALLADIUM GROUP			700954
BULL RESEARCH COUNCIL ISRAEL SECT F, 9F, 141 (1961)			700954
NSA 15, 24123 (1961)			700954
SHAFFER, P			
(CARBORUNDUM CO	NIAGARA FALLS	NY)	700941
DEVELOPMENT OF ULTRA REFRACTORY MATERIALS			700941
NP-10137			700941
NSA 15, 18261 (1961)			700941
SHAFFER, P			
(CARBORUNDUM CORP	NIAGARA FALLS	NY)	701057
DEVELOPMENT OF ULTRA REFRACTORY MATERIALS			701057
NP-10526 (1961)			701057
NSA 15, 28042 (1961)			701057
SHAFFER, P T B			
(CARBORUNDUM CO	NIAGARA FALLS	N Y)	202132
HIGH TEMPERATURE FORMS OF ZIRCONIUM AND TANTALUM MONOCARBIDES			202132
J AM CERAM SOC 46, 177 (1963)			202132
CA 59, 7223 (1963)			202132
SHAFFER, P T B			
(CARBORUNDUM CO	NIAGARA FALLS	N Y)	202133
AN OXIDATION RESISTANT BORIDE COMPOSITION			202133
AM CERAMIC SOC BULLETIN 41, 96 (1962)			202133
SHAKHOVA, K BUDBERG, P			
ALLOYS OF THE TITANIUM-NIOBIUM SYSTEM			201234
IZVEST AKAD NAUK SSSR OTDEL TEKH, NAUK MET I .3PLIV0			201234
1961, NO 4, 56 (1961)			201234
CA 56, 1251 (1962)			201234
SHAKHOVA, K BUDBERG, P			
PHASE DIAGRAM OF THE TITANIUM-NIOBIUM-CHROMIUM SYSTEM			300993
IZV A N SSSR O T N MET I TOP 1962, NO 6, 137 (1962)			300993
SHAPIRO, E			
VAPOR PRESSURE OF THORIUM OXIDE FROM 2050 TO 2250 DEGREES K			100186
J AM CHEM SOC 74, 5233 (1952)			100186
CA 47, 10935 (1953)			100186
NSA 7, 69 (1953)			100186
SHAPIRO, Z			
(WESTINGHOUSE ELEC CORP	PITTSBURGH	PA)	601296
RESUME OF URANIUM OXIDE DATA III			601296
WAPD-PMM-197 DECL 1957			601296
NSA 11, 12437 (1957)			601296
SHAPIRO, I WILSON, C DITTER, J LEHMANN, W			
MASS SPECTROMETRY IN BORON CHEMISTRY			201356
			201356

ADVANCES IN CHEM SER 32, 127 (1961)	201356
CA 56, 6775 (1962)	201356
SHAPIRO, Z	601512
(WESTINGHOUSE ELEC CORP PITTSBURGH PA)	601512
RESUME OF URANIUM OXIDE-III	601512
WAPD-PMM-167 (1957)	601512
NSA 12, 1919 (1958)	601512
SHARMA, B	301194
(UNIV SOUTHERN CALIF LOS ANGELES CALIF)	301194
INTERATOMIC DISTANCES IN URANIUM CARBIDE	301194
ACTA CRYST 16, 322 (1963)	301194
BHT NO 20, (1963)	301194
SHARAN, B	301070
EVALUATION OF VIBRATION SPECTRUM AND HEAT CAPACITY OF	301070
TUNGSTEN AND MOLYBDENUM BY DE LAUNAYS ELECTRON GAS MODEL	301070
PHYSICS STATUS SOLIDI 1, (1961)	301070
REV MET LIT 19, (1962)	301070
SHARAN, B SINGH, S	600654
LATTICE FREQUENCIES AND SPECIFIC HEATS OF GERMANIUM AND	600654
SILICON	600654
J SCI RESEARCH BANARAS HINDU UNIV 10, 60 (1959)	600654
CA 55, 8059 (1961)	600654
SHARP, D	200931
(CHEM SOC LONDON ENGLAND)	200931
TRANSITION ELEMENTS	200931
ANN REPTS PROG CHEM 56, 130 (1959)	200931
CA 55, 9131 (1961)	200931
SHARPE, A SHARP, D	201831
(CHEM SOC LONDON ENGLAND)	201831
INORGANIC CHEMISTRY INTRODUCTION	201831
ANN REPT PROGR CHEM 58, 79 (1961)	201831
CA 57, 10747 (1962)	201831
SHARUPIN, B VASILKOVA, I	700665
RULES IN ENTHALPIES OF FORMATION OF OXIDES AND OXYCHLORIDES	700665
ZHUR OBSHCHEI KHIM 31, 2077 (1961)	700665
CT NO 15, (1961)	700665
SHAW, C	600908
SOFT X-RAY SPECTRA OF METALS AND ALLOYS	600908
AECU-3578, (1956)	600908
SHAW, J	600759
(OHIO STATE UNIV COLUMBUS OHIO)	600759
NITRIC OXIDE FUNDAMENTAL	600759
J CHEM PHYS 24, 399 (1956)	600759
CA 50, 8326 (1956)	600759
SHCHEGROV, L	600825
THE REACTION BETWEEN TITANIUM TETRACHLORIDE AND OXYGEN	600825
TRUDY URAL POLITEKH INST IM S M KIROVA NO 96, 82 (1960)	600825
CA 55, 19424 (1961)	600825
SHCHEPOCHKINA, N	200958
(ACAD SCI MOSCOW RUSSIA)	200958
PHYSICAL-CHEMICAL INVESTIGATION OF THE SYSTEMS BEO-TI02 AND	200958
FF0-TI02	200958

TRUDY 5-G0 (PYATOG0) SOVESHCHAN EKSPIT I TEKH MINERAL I PETROG AKAD NAUK SSSR INST KHIM SILIKATOV Leningrad 1956, 493 (1958)	200917 200918 200919 200958
CA 55, 11054 (1961)	
SHCHERBAKOV, V VEYTSMAN, R STEGENDO, Z ANALYSIS OF TITANIUM, CHROMIUM AND ZIRCONIUM BORIDES FTD-TT-62-1825	300954 300984 300984
TRUDY INSTITUT METALL I SPET SPLAVOV SEMINAR PO ZHAR MATERIALAM N0 6, 52 (1960)	300984 300984
COTS N0 60, 84 (1962)	300984 300984
SHCHUKAREV, S ORANSKAYA, M TOLMACHEVA, T ILINSKII, Y THERMAL DISSOCIATION OF VANADIUM DICHLORIDE ZHUR NEORG KHIM 5, 8 (1960)	201162 201162 201162
CA 55, 21778 (1961)	201162
SHCHUKAREV, S KOKOVIN, G DETERMINATION OF THE HEAT OF FORMATION OF TUNGSTEN HEXABROMIDE	201159 201159 201159
ZHUR NEORG KHIM 5, 507 (1960)	201159
CA 55, 21775 (1961)	201159
SHCHUKAREV, S KOLBIN, N PREPARATION OF OSMIUM TRIBROMIDE ZHUR NEORG KHIM 6, 1246 (1961)	201231 201231 201231
CA 56, 1128 (1962)	201231
SHCHUKAREV, S MOROZOVA, M PRON, G ENTHALPY OF FORMATION OF COMPOUNDS OF CALCIUM WITH ELEMENTS OF THE MAIN SUBGROUP OF THE IV TH GROUP ZHUR OBSHCHEI KHIM 32, N0 7, 2069 (1962)	300598 300598 300598 300598
SHCHUKAREV, S MOROZOVA, M STOLYAROVA, T ENTHALPY OF FORMATION OF MANGANESE COMPOUNDS WITH THE ELEMENTS OF THE MAIN SUBGROUP OF GROUP V ZHUR OBSHCHEI KHIM 31, 1773 (1961)	700666 700666 700666 700666
CT N0 15, (1961)	700666
SHCHUKAREV, S NOVIKOV, G SUVOROV, A BAEV, A STATE UNIV Leningrad Leningrad USSR THERMODYNAMIC BASES OF CHLORINATION PROCESS 2. NATURAL TUNGSTEN COMPOUNDS	200800 200800 200800 200800
CHISTYE METAL I POLUPROVOD, TRUDY 1-01 (PERVOI) MEZHVUZ KONF, MOSCOW 1957, 150 (1959)	200800 200800
CA 55, 1169 (1961)	200800
SHCHUKAREV, S ORANSKAYA, M SHEMYAKINA, T ENTHALPY OF FORMATION OF NIOBIUM PENTACHLORIDE ZHUR NEORG KHIM 5, 2135 (1960)	200944 200944 200944
CA 55, 10040 (1961)	200944
SHCHUKAREV, S SEMENOV, G A MASS-SPECTROMETRIC STUDY OF THE VAPOR COMPOSITION OF THE OVER RARE-EARTH OXIDES DOKLADY AKAD NAUK SSSR 141, 652 (1961)	300653 300653 300653 300653
NSA 16, 7533 (1962)	300653
SHCHUKAREV, S A SEMENOV, G A EVAPORATION OF HAFNIUM DIOXIDE IZV VYS UCHEB ZAV KHIM I KHIM TEKH N0 5 5845 (1963)	301352 301352 301352
RUSS ACC VOL 16, N0 1, 149 APRIL (1963)	301352

SHCHUKAREV, S A SEMENOV, G A FRANTSEVA, K E	301353
MASS SPECTROMETRIC STUDY OF THE SUBLIMATION OF SOME VANADIUM	301353
AND NIOBIUM OXIDES	301353
ZHUR NEORG KHIM 4, 2638 (1959)	301353
CA 54, 14848E (1960)	301353
SHCHUKAREV, S A SEMENOV, G A FRANTSEVA, K E	301354
MASS SPECTROMETRIC STUDY OF NbO EVAPORATION	301354
IZV VYS UCHEB ZAV KHIM I KHIM TEKH NO 5 5691 (1962)	301354
RUSS ACC VOL 16, NO 1, 186 APRIL (1963)	301354
SHCHUKAREV, S SEMENOV, G FRANTSEVA, K	300744
DETERMINATION OF SATURATED VAPOR PRESSURE OF NIOBIUM-DIOXIDE	300744
DOKLADY AKAU NAUK SSSR 145, NO 1, 119 (1962)	300744
NSA 16, 30386 (1962)	300744
SHCHUKAREV, S SEMENOV, G RATKOVSKII, I	300837
DETERMINATION OF THE SATURATED VAPOR PRESSURE OF	300837
GALLIUM OXIDE	300837
ZHUR NEORG KHIM NO 8, 1009 (1961)	300837
COTS 56, 416 (1962)	300837
SHCHUKAREV, S SMIRNOVA, E VASILKOVA, I BOROVSKAYA, N	201748
ENTHALPIES OF FORMATION OF NIOBIUM PENTA BROMIDE AND	201748
OXYTRIBROMIDE	201748
ZH NEORGAN, KHIM 7, 1213 (1962)	201748
CA 57, 6698 (1962)	201748
SHCHUKAREV, S SMIRNOVA, E VASILKOVA, I LAPP0, L	200799
ENTHALPY OF FORMATION OF TANTALUM PENTACHLORIDE AND	200799
PENTABROMIDE	200799
VESTNIK LENNINGRAD UNIV 15, NO 16	200799
SER FIZ I KHIM NO 3, 113 (1960)	200799
CA 55, 1169 (1961)	200799
SHCHUKAREV, S SUVOROV, A	201051
THERMODYNAMIC INVESTIGATION OF SOME CHLORINE DERIVATIVES OF	201051
MOLYBDENUM AND TUNGSTEN	201051
VESTNIK LENINGRAD UNIV 16, NO 4, SER FIZ I KHIM NO 1, 87 (1961)	201051
CA 55, 16117 (1961)	201051
SHCHUKAREV, S TOLMACHEVA, T TSINTSIUS, V	201809
DISPROPORTIONATION OF VANADIUM TRIBROMIDE AT HIGH TEMPERATURES	201809
ZH NEORGAN KHIM 7, 1505 (1962)	201809
CA 57, 9445 (1962)	201809
SHCHUKAREV, S TOLMACHEVA, T TSINTSIUS, V	201540
THERMODYNAMIC CHARACTERISTICS OF VANADIUM BROMIDES	201540
ZH NEORGAN, KHIM 7, 679 (1962)	201540
CA 56, 14999 (1962)	201540
SHCHUKAREV, S VASILKOVA, I DR0ZDOVA, V	200847
HEAT OF FORMATION OF URANYL BROMIDE AND URANIUM	200847
MONOXYTRIBROMIDE	200847
ZHUR NEORG KHIM 3, 2651 (1958)	200847
CA 55, 4134 (1961)	200847
SHCHUKAREV, S VASILKOVA, I MARTYN0VA, N MALTSEV, Y	200798
HEAT OF FORMATION OF URANYL CHLORIDE AND URANIUM	200798
0XYTRICHLORIDE	200798
ZHUR NEORG KHIM 3, 2647 (1958)	200798
CA 55, 1169 (1961)	200798

SHCHUKAREV, S VASILKOVA, I SHARUPIN, B	201459
(VESTNIK Leningrad Univ Leningrad RUSSIA)	201459
MOLYBDENUM HALIDES V THERMODYNAMICS OF MOO2CL2 AND MO-02CL2	201459
H2O	201459
VESTNIK Leningrad Univ 16, NO 22, SE FIZ I KHIM NO 4, 130	201459
(1961)	201459
CA 56, 11003 (1962)	201459
SHCHUKAREV, S VASILKOVA, I ZAITSEVA, N	201413
(VESTNIK Leningrad Univ Leningrad RUSSIA)	201413
MOLYBDENUM HALIDES. DETERMINATION OF THE ENTHALPY OF	201413
FORMATION OF MOLYBDENUM TETRABORIDE	201413
VESTNIK Leningrad Univ 16, NO 22, SER FIZ I KHIM NO 4, 127	201413
(1961)	201413
CA 56, 9510 (1962)	201413
SHENSTONE, A	700636
SECOND SPECTRUM OF SILICON	700636
PROC ROY SOC (LONDON) 261A, 153 (1961)	700636
CT NO 12, (1961)	700636
SHEWCHUCK, S	601252
SUMMARY OF RESEARCH PROGRESS MEETING OF NOV. 6, 1952	601252
UCRL-2068 (1952)	601252
NSA 7, 2588 (1953)	601252
SHIFFMAN, C	601636
THE HEAT CAPACITIES OF THE ELEMENTS BELOW ROOM TEMPERATURE	601636
NP-4945 (1952)	601636
SHIMAZAKI, E NIWA, K	201503
(HOKKAIDO UNIV SAPPORO JAPAN)	201503
VAPOR-PRESSURE MEASUREMENTS ON RARE EARTH HALIDES	201503
Z ANORG ALLGEM CHEM 314, 21 (1962)	201503
CA 56, 13561 (1962)	201503
SHIMIZU, M TAKAHASHI, T KATSUKI, A	202135
(UNIV NAGOYA NAGOYA JAPAN)	202135
MAGNETIC SUSCEPTIBILITY AND ELECTRONIC SPECIFIC HEAT OF	202135
TRANSITION METALS AND ALLOYS	202135
J PHYS SOC JAPAN 18 (8), 1192 (1963)	202135
CA 59, 7047B (1963)	202135
SHIRO, JUJIN MORIHIRO, OKADA	301452
(GOVT IND RES INST NAGOYA JAPAN)	301452
MELTING OF ALUMINUM-MAGNESIUM ALLOYS UNDER LOW PRESSURE	301452
EVAPORATION OF MAGNESIUM FROM A MOLTEN ALLOY UNDER LOW	301452
PRESSURE	301452
NAGOYA KUGYO GIJUTSU SHIKENSHO HOKOKU 11, 676 (1962)	301452
CA 58, 12240E (1963)	301452
SHISHAKOV, N	601121
STRUCTURE OF THE OXIDE PT02	601121
KRISTALLOGRAFIYA 2, 689 (1957)	601121
CA 53, 7712 (1959)	601121
SHKHAREVSKII, B VISHNEVSKII, I GARVISH, A	201707
DECOMPOSITION OF SOLID SOLUTIONS IN THE PR02-CA0 SYSTEM	201707
DOKL AKAD NAUK SSSR 140,884 (1961)	201707
CA 57, 5344 (1962)	201707
SHKLYAREVSKII, I YAROVAYA, R	201326
OPTICAL PROPERTIES OF BERYLLIUM IN THE INFRARED SPECTRAL REGION	201326

OPTIKA I SPEKTRASKIPIYA 11, 661 (1961)	201326
CA56, 5544 (1962)	201326
SHØLETTE, W PORTER, R	300988
MASS SPECTROMETRIC STUDY OF THE HIGH TEMPERATURE REACTIONS	300988
IN THE BORON-HYDROGEN-OXYGEN SYSTEM	300988
J PHYS CHEM 67, 177 (1963)	300988
SHMIDT, N SØKØLØV, V	201590
ADIABATIC CALORIMETER FOR DETERMINATION OF SPECIFIC HEATS	201590
BETWEEN 30 AND 750 DEGREES OF SUBSTANCES WITH LOW THERMAL	201590
CONDUCTIVITY, SUCH AS, CORUNDUM	201590
ZH NEORGAN KHIM 5, 1641 (1960)	201590
CA 57, 603 (1962)	201590
SHPIRAYN, E ASINØVSKIY, E	301099
LATENT HEAT OF VAPORIZATION FOR ALKALI METALS	301099
INZHENERNO-FIZ ZHUR 5, NØ 4, 35 (1962)	301099
CØTS 55, 211 (1962)	301099
SHUBERT, J	701036
BERYLLIUM	701036
MCGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY	701036
MCGRAW-HILL BØØK CØ (1960)	701036
NSA 15, 9493 (1961)	701036
SHUKURØV, A NIKØLSKAYA, T VASILKØVA, I SHCHUKAREV, S	201907
DETERMINATION OF THE HEATS OF FORMATION OF MØLYBDENUM	201907
DI-AND TRIBROMIDES	201907
IZV AKAD NAUK TADZH SSR ØTD GEØL-KHIM I TEKHN NAUK NØ 4, 23	201907
(1961)	201907
CA 57, 14498 (1962)	201907
SHULISHØVA, Ø	301587
(INS: METALLØKERAM SPLAVØV SSSR)	301587
CALCULATION OF THE CRYSTAL LATTICE ENERGY OF INØRGANIC	301587
CØMPØUNDS	301587
AKAD NAUK UKR (SSR) (1962)	301587
CA 58, 4027 (1963)	301587
SHVARTS, G L SHEVELKIN, B N TØRØPØV, V A	202136
TITANIUM, A NEW MATERIAL FOR CHEMICAL EQUIPMENT	202136
ZH VSES KHIM ØBSHCHESTVA IM D I MENDELEEVA 8, 317 (1963)	202136
CA 59, 7205H (1963)	202136
SHVEIKIN, G	301588
REACTION OF TUNGSTEN CARBIDE WITH ØXIDES OF REFRACTØRY METALS	301588
IN VACUØ	301588
PØRØSHKØVAYA, MET, AKAD, NAUK UKR (SSR) 2 NØ 6, 67 (1962)	301588
CA 58, 7671 (1963)	301588
SHVEIKIN, G	300151
INTERMEDIATE NIØBIUM CØMPØUNDS IN THE REDUCTION OF NIØBIUM	300151
PENTØXIDE WITH CARBØN	300151
TRUDY INST KHIM, AKAD NAUK SSSR URAL FIL NØ 2, 51 (1958)	300151
AEC-TR-4304	300151
NSA 15, 5989	300151
SHVEIKIN, G	600671
THERMØDYNAMIC ANALYSIS OF EQUILIBRIUM IN THE NIØBIUM-OXYGEN	600671
CARBØN SYSTEM	600671
TRANSLATED FROM TRUDY INST KHIM AKAD NAUK SSSR URAL	600671
FILIAL NØ 2, 45 (1958)	600671

AEC-TR-4303 NS 15, 5988 (1961)	600671 600671
SHVEIKIN, G P (INST CHEM ACAD SEI SVERDLOVSH USSR) KINETICS OF THE REDUCTION OF NIOBIUM PENTOXIDE WITH CARBON IN VACUO TRUDY INST KHIM AKAD NAUK SSSR URAL FILIAL NO 2, 57 (1958) CA 54, 19125D (1960)	301355 301355 301355 301355 301355 301355
SHVEIKIN, G P GELD, P V THE LOWER OXIDES OF NIOBIUM ZH NEORG KHIM 3, 2437 (1958) AEC TR 4459 NSA 16, 17631	301356 301356 301356 301356 301356
SHVEIKIN, G P GELD, P V ALYAMOVSKII, S I CONDITIONS OF THE FORMATION OF NIOBIUM OXYCARBIDES ZH NEORGAN KHIM 8, NO 3, 689 (1963)	301357 301357 301357
SHVEIKIN, G GELD, P LYUBIMOV, V EFFECT OF RECRYSTALLIZATION OF NIOBIUM PENTOXIDE ON ITS REDUCTION RATE IZVEST VYSSHIKH UCHEB ZAVEDENII TSVEYNAYA MET 3, 3, 120 (1960) CA 55, 6087 (1961)	200762 200762 200762 200762 200762
SIDEROTTEM, B WHITE, J (UNIV SHEFFIELD SHEFFIELD ENGLAND) PHASE RELATIONS IN NONCONDENSED OXIDE (TERNARY) SYSTEMS TRANS BRIT CERAM SOC 60, 96 (1961) CA 55, 16110 (1961)	201048 201048 201048 201048 201048
SIDELES, P DANIELSON, G THERMAL CONDUCTIVITY OF METALS AT HIGH TEMPERATURES ISC-198 (1951) NSA 6, 2680 (1952)	601238 601238 601238 601238
SIDOROV, T (P N LEBEDEV PHYS INST MOSCOW RUSSIA) INFRARED SPECTRA AND THE STRUCTURE OF SOME GLASS-FORMING OXIDES TRUDY FIZ INST IM P N LEBEDEVA AKAD NAUK SSSR 12, 225 (1960) CA 55, 16168 (1961)	201055 201055 201055 201055 201055
SIEGEL, B (AEROSPACE CORP EL SEGUNDO CALIF) RELATION OF EXOTHERMICITIES OF COMPOUNDS TO CHEMICAL BONDING J CHEM EDUC 40, 308 (1963) CA 59, 2177E (1963)	301360 301360 301360 301360 301360
SIEGEL, B (AEROSPACE CORP EL SEGUNDO CALIF) STABLE GASEOUS SPECIES AT HIGH TEMPERATURES J CHEM EDUC 43(6), 304 (1963) CA 59, 2176F (1963)	301359 301359 301359 301359 301359
SIEGEL, B SIEGEL, S CALCULATION OF VALENCE STATE ENERGIES FROM THERMOCHEMICAL DATA NATURE 199, 591 (1963)	301361 301361 301361
SIEGEL, S (ARGONNE NATL LAB LEMONT ILL) THE CRYSTAL STRUCTURE OF TRIGONAL U3O8 ACTA CRYST 8, 617 (1955)	601267 601267 601267 601267

NSA 10, 113 (1956)	601267
SIEGEL, S SIEGEL, B	301358
(AEROSPACE CORP EL SEGUNDO CALIF)	301358
INTRINSIC BOND ENERGIES	301358
J CHEM EDUC 43 (3), 143 (1963)	301358
CA 59, 2178A (1963)	301358
SIEMENS, W	600949
(UNIV GÖTTINGEN GERMANY)	600949
HYPERFINE STRUCTURE IN THE IRIIDIUM I SPECTRUM AND THE	600949
NUCLEAR MOMENT OF THE STABLE IRIIDIUM ISOTOPE	600949
ANN PHYS 13, 136 (1953)	600949
CA 48, 11919 (1954)	600949
SIEMS, P L	301362
(COLORADO SCHOOL OF MINES RE COLORADO)	301362
BERYLLIUM	301362
COLORADO SCHOOL MINES MINERAL IND BULL 6, 15 (1963)	301362
CA 59, 1333C (1963)	301362
SILCOX, N DILLON, G ARMINGTON, A	201734
(A F CAMB RES LABS BEDFORD MASS)	201734
PREPARATION OF HIGH-PURITY CHROMIUM	201734
ULTRAPURIF SEMICONDUCTOR MATER PROC CONF BOSTON MASS 1961,	201734
164-72 (1962)	201734
CA 57, 5757 (1962)	201734
SILVER, M D FARRAR, P A KOMAREK, K L	202137
THERMODYNAMIC PROPERTIES AND LATTICE PARAMETERS OF HAFNIUM	202137
OXYGEN ALLOYS	202137
TRANS AIME 227, 876 (1963)	202137
SILVER, A KUSHIDA, T	300987
(SC) LAB FOMOCO DEARBORN MICH)	300987
NUCLEAR MAGNETIC RESONANCE IN TRANSITION-METAL DIBORIDES	300987
J CHEM PHYS 38, NO 4, 865 (1963)	300987
SILVERMAN, L	601364
(ATOMICS INTERNATIONAL CANOGA PARK CAL)	601364
THE HIGH TEMPERATURE CHEMICAL REACTIVITIES OF	601364
THE URANIUM CARBIDES	601364
NAA-SR-MEMO 4269	601364
NSA 14, 2731 (1960)	601364
SIMANOV, Y LAPITSKIY, A ET AL	301119
SOME PROPERTIES OF TANTALUM PENTOXIDE	301119
VEST MOSKOV UNIV SER FIZ MATEMAT I YESTEST NAUK 9,	301119
NO. 9, 109 (1954)	301119
COTS 55, 219 (1962)	301119
SIMMONS, C FUNSTON, E MAGEE, C MCGURTY, J CALKINS, V	700808
(G E CO CINCINNATI OHIO)	700808
CHEMISTRY AND METALLURGY OF YTTRIUM	700808
APEX-475 (DEL)	700808
NUCL SCI ABSTR 15, 23929 (1961)	700808
SINGH, N	600703
A NEW BAND SYSTEM OF BORON MONOXIDE	600703
PROC INDIAN ACAD SCI 29A, 424 (1949)	600703
SINGLETON, E CARPENTER, L LUNDQUIST, R	201560
(U S BUREAU OF MINES BOULDER CITY NEV)	201560

STUDIES OF THE $MnO-SiO_2$ BINARY SYSTEM	201560
U S BUR MINES DEPT INVEST NØ 5938. (1962)	201560
CA 57, 120 (1962)	201560
SKIDMØRE, I MØRRIS, E	601607
(AT WPNS RES EST ALDERMASTØN ENGLAND)	601607
EXPERIMENTAL EQUATION OF STATE DATA FOR URANIUM AND ITS	601607
INTERPRETATION IN THE CRITICAL REGION	601607
IAEA SYMP PROC VIENNA. (1962)	601607
NSA 16, 25376 (1962)	601607
SKINNER, B	601065
(HARVARD UNIV CAMBRIDGE MASS)	601065
THE THERMAL EXPANSIONS OF THØRIA, PERICLASE, AND DIAMØND	601065
AM MINERALØGIST 42, 39 (1957)	601065
CA 51, 15916 (1957)	601065
NSA 11, 3827 (1957)	601065
SKINNER, G BECKETT, C JØHNSTØN, H	601225
THERMAL, STRUCTURAL, ELECTRICAL, MAGNETIC, AND ØTHER	601225
PHYSICAL PRØPERTIES OF TI,ZR,HF AND TH AND SØME OF THEIR	601225
SIMPLE CØMPØUNDS. TH AND ITS HYDRIDES, ØXIDES, HALIDES,	601225
NITRIDE CARBIDES AND THE ALKALINE EARTH THØRATES	601225
CØNTRACT W-33-Ø38AC-17721 TECH REPT 102-AC49/2-100-4	601225
NSA 8, 4046 (1954)	601225
SKINNER, H	700761
(UNIV MANCHESTER MANCHESTER ENGLAND)	700761
VALENCE STATES OF SØME ELEMENTS FROM GRØUPS 2, 3, AND 4	700761
CØNFIGURATIONS CØNTAINING D-ØRBITALS	700761
TRANS FARADAY SØC 51, 1036 (1955)	700761
CA 50, 3813 (1956)	700761
SKINNER, H WADDINGTON, G WESTRUM, E	301589
BULLETIN OF THERMØDYNAMICS AND THERMØCHEMISTRY, NØ 6	301589
CA 59, 5862 (1963)	301589
SKURATØV, S KØLESØV, V	300251
FIRST ALL-UNION CØNFEREÑCE ØN CALØRIMETRY	300251
ZHUR FIZ KHIM 35, NØ 8 1896 (1961)	300251
SLACK, G	201125
(GEN ELECT RES LAB SCHENECTADY NY)	201125
THERMAL CØDUCTIVITY OF CaF_2 , MnF_2 , CoF_2 AND ZnF_2 CRYSTALS	201125
PHYS REV 122, 1451 (1961)	201125
CA 55, 19450 (1961)	201125
SLATER, J	600905
ELECTRØNIC STRUCTURE OF ATØMS AND MØLECULES	600905
NP-4541, (1953) TECHNICAL REPRØT 3 (1953)	600905
ØLEPTØV, V SAMSONØV, G	200766
KINETIC PARAMETERS OF THE NITRIDATION OF BØRØN	200766
DØPØVIDI AKAD NAUK UKR R S R 1959, . 16 (1959)	200766
CA 55, 7001 (1961)	200766
SMAGINA, E KUTSEV, V ØRMØNT, B	300345
INVESTIGATION OF THE EQUILIBRIUM IN THE SYSTEM ZIRCØNIUM	300345
NITRØGEN AT HIGH TEMPERATURES AND OF THE FREE ENERGY	300345
OF FØRMATION OF ZRN AS A FUNCTION OF ITS CØMPØSITION	300345
AND STRUCTURE	300345
PRØBLEMY FIZ KHIM 2, 118 (1959)	300345
JPRS-10232	300345

COTS 46,198 (1961)	300345
NSA 15, 32554 (1961)	300345
SMALLMAN-TEW, R	301157
(NAT RES COUNCIL OTTAWA CANADA)	301157
A REVIEW OF THE REFRACTORY METALS	301157
CAN AERØ SPACE J.9, (1) 15 (1963)	301157
BHT NØ 1, 11 (1963)	301157
SMILTENS, J	301059
(A F CAMB RES CTR BEDFØRD MASS)	301059
THE STANDARD FREE ENERGY OF FØRMATION OF SILICØN CARBIDE	301059
J PHYS CHEM 64, 368 (1960)	301059
SMILTENS, J	200771
(A F CAMB RES CTR BEDFØRD MASS)	200771
THEORY OF GASEØS EQUILIBRIUMS IN THE SILICØN-CARBIDE BINARY	200771
SYSTEM	200771
SILICØN CARBIDE, PROC CONF, BØSTØN 1959, 3 (1960)	200771
CA 55, 7014 (1961)	200771
SMIRNØV, M NICHKØV, I RASPØPIN, S PERFILEV, M	201191
THERMØDYNAMIC STUDY OF THE REACTION $UO_2(S)$ PLUS $1/2C(G)$	201191
PLUS $CL_2(G)$ EQUALS $UOCL_2(S)$ PLUS $1/2CØ_2(G)$ BY THE EMF METHØD	201191
DØKLADY AKAD NAUK SSSR 130, 581 (1960)	201191
CA 56, 73 (1962)	201191
SMIRNØV, M KØMARØV, V BARABØSHKIN, A	201056
EQUILIBRIUM PØTENTIALS OF ZIRCØNIUM IN MØLTEN FLUØRIDE-CHLØRIDE	201056
MIXTURES	201056
DØKLADY AKAD NAUK SSSR 133, 409 (1960)	201056
CA 55, 16219 (1961)	201056
SMIRNØV, M CHUKREEV, N	700523
IN ESTIGATION OF THE THERMØDYNAMICS OF THE REDUCTION OF	700523
BERYLLIUM ØXIDE BY CARBØN	700523
ZHUR NEØRG KHIM 3, 2445 (1958)	700523
CE 44, 102 (1961)	700523
NSA 15, 11473 (1961)	700523
SMIRNØV, M PALGUEV, S	300297
BEHAVIØR OF ANØDES MADE OF AN INTIMATE MIXTURE OF TITANIUM	300297
DIOXIDE WITH CARBØN DURING AN ELECTRØLYSIS OF FUSED SALT	300297
TRUDY INST ELEKTRØKHIM AKAD NAUK SSSR URAL FIL 1960, NØ 1	300297
29 (1960)	300297
CA 55, 19551 (1961)	300297
SMIRNØV, M SKIRA, Ø	300992
ØXIDATION-REDUCTION PØTENTIAL OF THE SYSTEM U_3+/U_4+ IN A	300992
NACL-KCL MELT	300992
DANSSSR 141, NØ 4, 904 (1961)	300992
SMIRNØVA, V ØRMØNT, B	300267
(L YA KARPØV PHYS-CHEM INST MØSC.W USSR)	300267
SURFACE TENSION DETERMINATION AT HIGH TEMPERATURES BY THE	300267
HANGING DRØP AND THE DRØP FØRMATION METHØDS	300267
ZHUR FIZ KHIM 33, 771 (1959)	300267
CA 54, 8196 (1960)	300267
SMITH, D	601249
ISØTØPE SPECTRUM SHIFT DATA ON URANIUM SPECTRUM LINES	601249
AFCØ-3481 ØRNL-1412 (1952)	601249
NSA 7, 1094 (1953)	601249

NSA 7, 1654 (1953)	601249
SMITH, D CLINE, C	201672
(UNIV OF CALIFORNIA LIVERMORE ENGLAND)	201672
VERIFICATION OF EXISTANCE OF CUBIC ZIRCONIA AT HIGH	201672
TEMPERATURE	201672
J AM CERAM SOC 45, 249 (1962)	201672
CA 57, 4130 (1962)	201672
SMITH, D CLINE, C SANDS, D	201483
(UNIV OF CALIFORNIA BERKELEY CALIF)	201483
X-RAY DATA FOR THE CHROME-URANIA SYSTEM, CR203-2U03	201483
NATURE 192, 861 (1961)	201483
CA 56, 12396 (1962)	201483
SMITH, D CLINE, C FRECHETTE, V	701073
(UNIV. CALIF LIVERMORE)	701073
A HIGH TEMPERATURE CRYSTALLOGRAPHIC PHASE INVERSION IN BEO	701073
J NUCL MATER 6, 265 (1962)	701073
NSA 17, 3517 (1963)	701073
SMITH, D MILLER, W TAYLOR JR, A	201542
(U S BUR MINES UNIV ALA)	201542
HIGH TEMPERATURE HEAT CONTENTS AND ENTROPIES OF ZIRCONIUM	201542
FLUORIDE AND ZIRCONIUM SULFATE	201542
U S BUR MINES REPT INVEST NO 5964 (1962)	201542
CA 56, 15002 (1962)	201542
SMITH, D MCNALLY, J	100197
ISOTOPE SHIFTS IN ENHANCED SAMARIUM ISOTOPES	100197
J OPT SOC AMER 40, 878 (1950)	100197
CA 47, 5793 (1953)	100197
SMITH, D STUKENBROEKER, G MCNALLY, J	400564
(OAK RIDGE NATL LAB OAK RIDGE TENN)	400564
NEW DATA ON ISOTOPE SHIFTS IN URANIUM SPECTRA, URANIUM (236)	400564
AND URANIUM (234)	400564
PHYS REV 84, 383 (1951)	400564
CA 46, 1865 (1952)	400564
SMITH, F	301590
(STANFORD RES INST MENLO PARK CALIFORNIA)	301590
COLLISION LIFETIMES AND THE THERMODYNAMICS OF REAL GASES	301590
J CHEM PHYS 38, 1304 (1963)	301590
CA 58, 8413 (1963)	301590
SMITH, J	201743
DETERMINATION OF THERMODYNAMIC FUNCTIONS FOR THE FORMATION OF	201743
BINARY INTERMETALLIC PHASES FROM VAPOR-PRESSURE MEASUREMENTS	201743
US AT ENERGY COMM 15-440, (1962)	201743
CA 57, 6694 (1962)	201743
SMITH, J	601073
(INST FO AT RES AMES IOWA)	601073
PHYSICAL CONSTANTS CRYSTAL STRUCTURE AND THERMODYNAMIC	601073
PROPERTIES	601073
PROC CONF METAL THOECUM CLEVELAND 1956 (HARLEY A WILHELM	601073
EDITOR AMER SOC FOR METALS) 133, 47 (1958)	601073
CA 52, 19858 (1958)	601073
SMITH, J CARLSON, C SPEDDING, F	700746
ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH	700746
ELEMENTS	700746

J METALS 9, 1212 (1957)	700746
CA 52, 1019 (1958)	700746
SMITH, J GJFVRE, J	700812
(IOWA STATE UNIV AMES IOWA)	700812
ELASTIC CONSTANTS OF YTTRIUM SINGLE CRYSTALS IN THE	700812
TEMPERATURE RANGE 4.2 TO 400 DEGREES K	700812
J APP PHYS 31, 645 (1960)	700812
SMITH, G S ALEXANDER, L E	202139
(MELLON INST PITTSBURGH PA)	202139
REFINEMENT OF ATOMIC PARAMETERS OF ALPHA-QUARTZ	202139
ACTA CRYST 16, 462 (1963)	202139
CA 59, 7041E (1963)	202139
SMITH, G S	202140
(MELLON INST PITTSBURGH PA)	202140
THE REGULARITY OF TETRAHEDRA IN QUARTZ	202140
ACTA CRYST 16, 542 (1963)	202140
CA 59, 7041G (1963)	202140
SMITH, K	601063
(ARGONNE NATL LAB LEMONT ILL)	601063
THERMAL CONDUCTIVITY OF URANIUM	601063
US ATOMIC ENERGY COMM ANL-5700 (1957)	601063
CA 51, 14401 (1957)	601063
NSA 11, 8246 (1957)	601063
SMITH, K SPALDING, I	300777
THE ATOMIC G VALUES OF SOME RARE-EARTH ATOMS	300777
PROC ROY SOC (LONDON) 265A, 133-40 (1961)	300777
CA 56, 12436 (1962)	300777
SMITH, P WOLCOTT, N	601137
THE SPECIFIC HEAT OF THORIUM AND URANIUM	601137
BULL INST INTERN-FRØID, ANNEXE 283, (1955)	601137
CA 53, 15743 (1959)	601137
SMITHELLS, C	700509
TUNGSTEN	700509
CHEMICAL PUBLISHING CO INC NEW YORK (1953)	700509
SODA, R	301591
(NATL INST IND HEALTH KAWASAKI-SHI JAPAN)	301591
DEFORMATION VIBRATION OF SiOH	301591
BULL CHEM SOC (JAPAN) 35, 1897 (1962)	301591
CA 58, 5166 (1963)	301591
SODA, R	201302
(NATL INST IND HEALTH KANAGAWA-KEN JAPAN)	201302
INFRARED ABSORPTION SPECTRA OF QUARTZ AND SOME OTHER SILICA	201302
MODIFICATIONS	201302
BULL CHEM SOC JAPAN 34, 1491 (1961)	201302
CA 56, 4262 (1962)	201302
SOFFER, B	201327
(MIT CAMBRIDGE MASS)	201327
OPTICAL AND INFRARED ABSORPTION SPECTRA OF RUTILE SINGLE	201327
CRYSTALS	201327
J CHEM PHYS 35, 940 (1961)	201327
CA 56, 5546 (1962)	201327
SOKOLOV, V NAZIMOVA, N	201622

STRUCTURE AND NATURE OF EXCITATION OF THE MAGNESIUM OXIDE SPECTRUM	201622
OPTIKA I SPEKTRØSKØPIYA 8, 573 (1960)	201622
CA 57, 2988 (1962)	201622
SØLACØLU, S	201694
THERMAL EQUILIBRIUM OF THE SYSTEM $MgO-MgO \cdot Al_2O_3(MgO, Fe_2O_3)-2MgO \cdot SiO_2-2CaO \cdot SiO_2$ WITH APPLICATIONS TO THE MECHANISM OF THE REACTIONS OF THE MAGNESITE REFRACTORIES	201694
ACAD REP POPULARE ROMINE STUDII CERCETARI MET 6, 425 (1961)	201694
CA 57, 4335 (1962)	201694
SØLTYK, V	301158
HIGH-PRECISION MEASUREMENT OF THE TEMPERATURE OF LIQUID METALS	301158
IND LAB (USSR) 28, (5) 625 (1962)	301158
BHT NO 1, 3 (1963)	301158
SØMMER, A WHITE, D LINEVSKY, M J MANN, D E	202141
INFRARED ABSORPTION SPECTRA OF B_2O_3 , B_2O_2 , AND B_2O IN SOLID ARGON MATRICES	202141
J CHEM PHYS 38, 87 (1963)	202141
PA 66, 8272 (1963)	202141
SØREL, M	600787
CRYSTALLOGRAPHY OF A PHASE TRANSFORMATION WITH THE AID OF THE KIKUCHI LINES	600787
COMPT REND 248, 2106 (1959)	600787
CA 55, 14001 (1961)	600787
SPACEK, V	200888
(USTAV VYZKUM RUD PRAGUE CZECH)	200888
ZIRCONIUM	200888
CHEM LISTY 55, 16 (1961)	200888
CA 55, 6308 (1961)	200888
SPACU, P GHEØRGHIU, C ZUBØV, L	201693
THE CHEMISTRY OF OSMIUM	201693
REV CHIM AKAD REP POPULAIRE ROMAINA 6, 323 (1961)	201693
CA 57, 4294 (1962)	201693
SPEDDING, F	301077
RARE EARTHS	301077
INTERNATIONAL SCIENCE AND TECHNOLOGY 4, (1962)	301077
REV MET LIT 19, (1962)	301077
SPEDDING, F DAANE, A	200853
(IOWA STATE UNIV AMES IOWA)	200853
THE RARE-EARTH METALS	200853
MET REVS 5, 297 (1960)	200853
CA 55, 4299 (1961)	200853
SPEDDING, F DAANE, A (EDITORS)	700907
THE RARE EARTHS	700907
. JOHN WILEY AND SØNS NEW YORK (1961)	700907
SPEDDING, F DAANE, A HERRMANN, K	700703
CRYSTAL STRUCTURES AND LATTICE PARAMETERS OF HIGH PURITY SCANDIUM, YTTRIUM, AND THE RARE EARTH METALS	700703
ACTA CRYST 9, 559 (1956)	700703
CA 50, 15165 (1956)	700703
SPEDDING, F DAANE, A HERRMANN, K	700872
ELECTRICAL RESISTIVITIES AND PHASE TRANSFORMATIONS OF	700872

LANTHANUM, CERIUM, PRASEODYMIUM AND NEODYMIUM J METALS 9, AIME TRANS 209, 895 (1957) CA 51, 16238 (1957)	700872 700872 700872
SPEDDING, F DAANE, A WAKEFIELD, G DENNISØN, D (IOWA STATE UNIV AMES IOWA) PREPARATION AND PROPERTIES OF HIGH PURITY SCANDIUM METAL TRANS AIME 218, 608 (1960) CA 54, 19387 (1960)	700713 700713 700713 700713 700713
SPEDDING, F EBERTS, R NAUMANN, A (IOWA STATE UNIV AMES IOWA) HEATS OF COMBUSTION OF SOME RARE EARTH METALS US AT ENERGY COMM FSC-934, (1955) CA 53, 17657 (1959)	601146 601146 601146 601146 601146
SPEDDING, F FLYNN, J (IOWA STATE COLL AMES IOWA) INTEGRAL HEATS OF SOLUTION OF RARE EARTH TRICHLORIDES J AM CHEM SOC 76, 1477 (1954) CA 48, 6805 (1954)	700822 700822 700822 700822 700822
SPEDDING, F FLYNN, J THERMOCHEMISTRY OF THE RARE EARTHSII. LANTHANUM, PRASE- ODYMIUM, SAMARIUM, GADOLINIUM, ERBIUM, YTTERBIUM, AND YTTRIUM J AM CHEM SOC 76, 1474 (1954) CA 48, 9175 (1954)	700824 700824 700824 700824 700824 700824
SPEDDING, F GSCHNEIDNER, K DAANE, A LANTHANUM-CARBON SYSTEM TRANS MET SOC AIME 215, 192 (1959) CERAM A 44, 192 (1961)	700687 700687 700687 700687
SPEDDING, F GSCHNEIDNER, K DAANE, A (IOWA STATE COLL AMES IOWA) CRYSTAL STRUCTURES OF SOME OF THE RARE EARTH CARBIDES JOUR AM CHEM SOC 80, 4499 (1958) CA 53, 2729 (1959)	700834 700834 700834 700834 700834
SPEDDING, F HANAK, J DAANE, A (IOWA STATE UNIV AMES IOWA) HIGH-TEMPERATURE ALLOTROPY AND THERMAL EXPANSION OF THE RARE-EARTH METALS J LESS-COMMON METALS 3, 110 (1961) CA 55, 17411 (1961)	201087 201087 201087 201087 201087 201087
SPEDDING, F MCKEOWN, J DAANE, A (AMES LAB AMES 966 8) THE HIGH TEMPERATURE THERMODYNAMIC FUNCTIONS OF CERIUM, NEODYMIUM, AND SAMARIUM J PHY CHEM 64, 289 (1960) NSA 14, 12564 (1960)	700570 700570 700570 700570 700570 700570
SPEDDING, F MILLER, C SOME CALORIMETRIC STUDIES OF THE METALS AND CHLORIDES OF CE AND ND ISC-167 (1951) NSA 6, 560 (1952)	601241 601241 601241 601241 601241
SPEDDING, F POWELL, J DAANE, A HILLER, M ADAMS, W (IOWA STATE COLL AMES IOWA) PREPARING PURE SCANDIUM OXIDE	700757 700757 700757

J ELECTROCHEM SOC 105, 683 (1958)	700757
CA 53, 2910 (1959)	700757
SPEISER, R	600661
RESEARCH ON THE OXIDATION BEHAVIOR OF TUNGSTEN	600661
AD-238301 (1960)	600661
NS 15, 4271 (1961)	600661
SPERNER, F	300371
ZIRCONIUM AND ITS APPLICATIONS	300371
METALL 15, 892 (1961)	300371
BHT NO 1, 9 (1962)	300371
SPERNER, F	300372
VANADIUM, METAL FOR THE FUTURE	300372
METALL 15, 988 (1961)	300372
BHT NO 1, 9 (1962)	300372
SPERNER, H	201787
HAFNIUM	201787
METALL 16, 679 (1962)	201787
CA 57, 8292 (1962)	201787
SPINK, D	200891
(CARBORUNDUM METALS CO ACRON NEW YORK)	200891
LESS COMMON ELEMENTS, REACTIVE METALS, ZIRCONIUM, HAFNIUM,	200891
AND TITANIUM	200891
IND ENG CHEM 53, 97 (1961)	200891
CA 55, 6319 (1961)	200891
SPIRIDONOV, V TATEVSKI, V	301592
(Lomonosov State Univ MOSCOW RUSSIA)	301592
REGULARITY IN THE INTERNUCLEAR DISTANCES OF DIATOMIC	301592
MOLECULES	301592
ZH FIZ KHIM 36, 2024 (1962)	301592
DOKL AKAD NAUK SSSR 138, 621 (1961)	301592
CA 58, 1915 (1963)	301592
SPITSYN, V AFONSKII, N TSVIELNIKOV, V	300619
THERMAL DECOMPOSITION OF ISOPOLYCHROMATES OF POTASSIUM	300619
ZHUR NEORG KHIM 5, 1505 (1960)	300619
CA 57, 1848 (1962)	300619
SPITSYN, V KOMISSAROVA, L MENKOV, A	300370
THE PRODUCTION AND SOME PROPERTIES OF METALLIC SCANDIUM	300370
DOKLADY AKAD NAUK SSSR 139, 903 (1961)	300370
BHT NO 1, 9 (1962)	300370
SPITSYN, V ZIMAKOV, I	301593
THE EFFECT OF RADIOACTIVITY OF MOLYBDENUM TRIOXIDE ON THE	301593
VELOCITY OF ITS EVAPORATION	301593
DOKL AKAD SCI 139, 3, 654 (1961) TRANSL P566	301593
SRB, V	201083
(VYSOKA SKOLA CHEM TECHNOL PRAGUE CZECH)	201083
PROPERTIES AND EVALUATION OF ELECTROLYTICALLY PREPARED SAMPLES	201083
OF MN02	201083
COLLECTION CZECHOSLOV CHEM COMMUNS 26, 1231 (1961)	201083
CA 55, 17329 (1961)	201083
STADELMAIER, H	201365
(N C STATE COLLEGE RALEIGH N C)	201365
TERNARY COMPOUNDS OF TRANSITION METALS, B-METALS AND	201365

METALLOIDS			201365
Z METALLK 52, 758 (1961)			201365
CA 56, 7014 (1962)			201365
STADELMAIER, H YUN, T			301594
(NØ CAROLINA STATE COLL	RALEIGH	NØ CAROLINA)	301594
TERNARY BORIDES HAVING THE CHROMIUM CARBIDE			301594
CR23C6 STRUCTURE			301594
Z METALLK 53, 754 (1962)			301594
CA 58, 7444 (1963)			301594
STALINSKI, B BIEGANSKI, Z			201045
(POLITECH	WRØCLAW	PØLAND)	201045
ADIABATIC SEMIMICRØ CALØRIMETER FØR THE TEMPERATURE RANGE			201045
23 TØ 370 DEGREES K. HEAT CAPACITY ØF TITANIUM AT 27 TØ 360			201045
DEGREES K			201045
RØCZNIKI CHEM 35, 273 (1961)			201045
CA 55, 16033 (1961)			201045
STARITZKY, E WALKER, D			601257
(LØS ALAMØS SCI LAB	LØS ALAMØS	NEW MEXICØ)	601257
CRYSTALLØGRAPHIC DATA, PØTASSIUM			601257
CØPPER DICYANIDE, KCU(CN)2			601257
ANAL CHEM 28, 419 (1956)			601257
NSA 10, 9185 (1956)			601257
STARITZKY, E			601292
(LØS ALAMØS SCI LAB	LØS ALAMØS	N MEXICØ)	601292
CRYSTALLØGRAPHIC DATA THØRIUM TETRANITRATE			601292
PENTAHYDRATE TH(NØ3)4-5H2Ø			601292
ANAL CHEM 28, 2021 (1956)			601292
NSA 11, 1451 (1957)			601292
STARITZKY, E			601030
(LØS ALAMØS SCI LAB	LØS ALAMØS	NEW MEXICØ)	601030
CRYSTALLØGRAPHIC DATA YTTRIUM SESQUIØXIDE Y2Ø3			601030
DYSPRØSIUM SESQUIØXIDE DY2Ø3 ERBIUM SESQUIØXIDE ER2Ø3			601030
YTTRIUM SESQUIØXIDE, YB2Ø3			601030
ANAL CHEM 28, 2022 (1956)			601030
CA 51, 1685 (1957)			601030
STARKE, E CHENG, C BECK, P			201730
(UNIV ILL	URBANA	ILL)	201730
LØW-TEMPERATURE SPECIFIC HEAT ØF TI ALLØYS WITH CSCL TYPE			201730
ØRDERED STRUCTURE			201730
PHYS REV 126, 1746 (1962)			201730
CA 57, 5686 (1962)			201730
STECURA, S CAMPBELL, W			201271
(U S BUR ØF MINES	CØLLEGE PARK	MD)	201271
THERMAL EXPANSIØN AND PHASE INVERSIØN ØF RARE EARTH			201271
ØXIDES			201271
US BUR MINES REPT INVEST NØ 5847 (1961)			201271
CA 56, 2965 (1962)			201271
STEEB, S			200882
(MAX-PLANCK-INS METALLFØRSCH STUTTART		GERMANY)	200882
SUPERSTRUCTURE PHASE IN THE SYSTEM URANIUM-ØXYGEN			200882
NATURWISSENSCHAFTEN 47, 465 (1960)			200882
CA 55, 6096 (1961)			200882
STEELE, D			301595
(UNIV CØLL	SWANSEA	ENGLAND)	301595

DISSOCIATION PRODUCTS OF C ₂	301595
SPECTROCHIM ACTA 19, 411 (1963)	301595
CA 58, 13296 (1963)	301595
STEELE, W NICHOLS, L STONE, F	301596
(HARVARD UNIV CAMBRIDGE MASS)	301596
THE DETERMINATION OF SILICON-CARBON AND SILICON-HYDROGEN	301596
BOND DISSOCIATION ENERGIES BY ELECTRON IMPACT	301596
J AM CHEM SOC 84, 4441 (1962)	301596
CA 58, 10743 (1963)	301596
STEPANOVA, A UMANSKII, M	601204
PARAMETERS OF UNIT CELLS OF HEXABORIDES OF METALS	601204
BOR TRUDY KONF KHIM BORA I EGØ SØEDINENII 1955, 102 (1956)	601204
CA 54, 4101 (1960)	601204
STEPANOVA, A ZHURAVLEV, N	601111
(IM V LOMONOSOV STATE UNIV MOSCOW USSR)	601111
X-RAY STUDY OF YBB ₆ , UB ₆ , AND GDB ₄	601111
KRISTALLOGRAFIYA 3, 94 (1958)	601111
CA 52, 9706 (1958)	601111
STEPANOVA, G ROZEN, A	200966
THE THERMAL DISSOCIATION OF MOLYBDENUM HEXACARBONYL	200966
FIZ METAL I METALLOVED AKAD NAUK SSSR 10, 650 (1960)	200966
CA 55, 11169 (1961)	200966
STEPIN, B D BLYUM, G Z SHVARTS, M M	202142
MEANS OF PURIFYING SILICON DIOXIDE FROM TRACE IMPURITIES	202142
KHIM PROM 1963, 138 (1963)	202142
STEPIN, B CHERNYAK, A	201576
THE CHLORINATION OF IRIIDIUM	201576
ZH NEORGAN KHIM 5, 2157 (1960)	201576
CA 57, 380 (1962)	201576
STERN, D MCKENNA, Q	200830
METAL BORIDES AND SILICIDES	200830
US 2, 936, 268, (1960)	200830
CA 55, 3247 (1961)	200830
STERN, K	300305
HIGH TEMPERATURE ELECTROCHEMISTRY	300305
AD 248496	300305
STEVENS, A E FERGUSON, H I S	202143
PHOTOELECTRIC INTENSITY MEASUREMENTS UPON BANDS OF	202143
THE SIN (B ₂ E PLUS-X ₂ E PLUS) SPECTRUM	202143
CANAD J PHYS 41, 240 (1963)	202143
PA 66, 8269 (1963)	202143
STEVENS, E WILHELM, A	301597
(IOWA STATE UNIV AMES IOWA)	301597
REDUCTION OF NIOBIUM PENTOXIDE BY CARBON	301597
AEC-15-339 FEB 1961	301597
GOVT PUB 2053 (1962)	301597
STEVENSON, J RUEHLE, A	201727
(MALLINCKRODT CHEM WORKS ST LOUIS MO)	201727
URANIUM METAL BY BOMB REDUCTION. VI. IGNITION TEMPERATURES OF	201727
MAGNESIUM METAL WITH UF ₄ , UO ₂ F ₂ , UO ₂ , U ₃ O ₈ , AND UO ₃	201727
US AT ENERGY COMM NYO-1339, (1953)	201727
CA 57, 5677 (1962)	201727

STEWART, R JOHNSON, V			301598
A COMPENDIUM OF THE PROPERTIES OF MATERIALS AT LOW			301598
TEMPERATURE			301598
(PHASE 11 WADD TR 60-56			301598
AD-272769			301598
STISHOV, S M BELOV, N V			301363
CRYSTALLINE STRUCTURE OF THE NEW CLOSE-GRAINED MODIFICATION			301363
OF SILICA SiO ₂			301363
DOKL AKAD NAUK SSSR 143, 951 (1962)			301363
TAB 63-3-2, 57 (1963)			301363
STISHOV, S POPOVA, S			201716
(STATE UNIV MOSCOW RUSSIA)			201716
NEW DENSE MODIFICATIONS OF SILICA			201716
GEOKHIMIYA 837, 1961			201716
CA 57, 5393 (1962)			201716
STOCKER, J			201102
THE STABILIZATION OF CUBIC SOLID SOLUTIONS OF ZrO ₂			201102
BULL SOC CHIM FRANCE 1961, 78 (1961)			201102
CA 55, 18236 (1961)			201102
STOICHEFF, B			600598
(NATL RES LABS OTTAWA CAN)			600598
HIGH RESOLUTION RAMAN SPECTROSCOPY OF GASES III RAMAN			600598
SPECTRUM OF NITROGEN			600598
CAN J PHYS 32, 630 (1954)			600598
CA 49, 718 (1955)			600598
STORMS, E			301023
(LOS ALAMOS SCI LAB LOS ALAMOS NEW MEXICO)			301023
REVIEW OF REFRACTORIES			301023
U S AT ENERGY COMM LAMS-2674, (1962)			301023
CA 58, 5358 (1963)			301023
STORMS, E KRIKORIAN, N			700980
(LASL LOS ALAMOS NEW MEXICO)			700980
THE NI0BIUM-NI0BIUM CARBIDE SYSTEM			700980
J PHYS CHEM 64, 1471 (1960)			700980
CA 55, 10036 (1961)			700980
NSA 15, 1878 (1961)			700980
STORMS, E KRIKORIAN, N KEMPTER, C			700979
(LASL LOS ALAMOS NEW MEXICO)			700979
CRYSTALLOGRAPHIC DATA ON NI0BIUM MONOCARBIDE			700979
ANAL CHEM 32, 1722 (1960)			700979
CA 55, 51 (1961)			700979
NSA 15, 1865 (1961)			700979
STORMS, E MCNEAL, R			300608
(LOS ALAMOS SCI LAB LOS ALAMOS N MEX)			300608
THE VANADIUM-VANADIUM CARBIDE SYSTEM			300608
J PHYS CHEM 66, 1401 (1962)			300608
STORONKIN, A SHULTS, M			300296
THERMODYNAMICS OF MULTICOMPONENT HETEROGENEOUS SYSTEMS			300296
PART 2 NECESSARY CONDITIONS FOR THE STABILITY OF HETEROGENEOUS			300296
SYSTEMS			300296
ZHUR FIZ KHIM 34, 1928 (1960)			300296
STORONKIN, A V MORACHEVSKII, A G SMIRNOVA, N A			202144

CERTAIN ASPECTS OF THE THERMODYNAMICS OF MULTICOMPONENT SYSTEMS	202144
ZH FIZ KHIM 37, 1213 (1963)	202144
	202144
STORONKIN, A V SMIRNOVA, N A	202145
THE THERMODYNAMICS OF MULTICOMPONENT HETEROGENEOUS SYSTEMS	202145
IV CONDITIONS OF EQUILIBRIUM AND STABILITY OF MULTICOMPONENT MULTIPHASE SYSTEMS	202145
RUSS J PHYS CHEM 36, 1058 (1962)	202145
	202145
STOUT, J HADLEY, W BRANDT, C	201122
(UNIV OF CHICAGO CHICAGO ILLINOIS)	201122
THERMAL AND MAGNETIC PROPERTIES OF MNR2 AT LOW TEMPERATURES	201122
US DEPT COM, OFFICE TECH SER PB REPT 143420 (1958)	201122
CA 55, 19406 (1961)	201122
	201122
STOVER, E WULFF, J	300282
(MIT CAMBRIDGE MASS)	300282
NICKEL-TITANIUM-CARBON SYSTEM	300282
TRANS AIME 215, 127 (1959)	300282
CA 53, 6969 (1959)	300282
	300282
ST PIERRE, G EBIHARA, W POOL, M SPEISER, R	300547
THE W-O SYSTEM	300547
TRANS AIME 224, NO 2, 259 (1962)	300547
BHT NO 2, 46 (1962)	300547
	300547
STRASHINSKAYA, L SAMSONOV, G SHILLER, E	201970
CONTACT REACTION BETWEEN METALLIC CARBIDES NITRIDES AND BORIDES WITH REFRACTORY METALS AT ELEVATED TEMPERATURES	201970
IZV AKAD NAUK SSSR OTD TEKH NAUK MET I TOPLIVO 5, 167 (1962)	201970
CA 58, 1188 (1963)	201970
	201970
STRAUMANIS, M EJIMA, T JAMES, W	201078
(UNIV OF MISSOURI ROLLA MISSOURI)	201078
THE TiO2 PHASE EXPLORED BY THE LATTICE CONSTANT AND DENSITY METHOD	201078
ACTA CRYST 14, 493 (1961)	201078
CA 55, 17152 (1961)	201078
PA 65, 6811 (1962)	201078
	201078
STRAUMANIS, M LI, H	200780
(UNIV OF MISSOURI ROLLA MISSOURI)	200780
LATTICE CONSTANTS, LINEAR COEFFICIENTS OF EXPANSION, DENSITIES, CAVITY ARRANGEMENT, AND STRUCTURE OF THE TITANIUM II OXIDE PHASE	200780
ANORG U ALLGEM CHEM 305, 143 (1960)	200780
CA 55, 51 (1961)	200780
	200780
STRAUMANIS, M EJIMA, T	300692
IMPERFECTIONS WITHIN THE PHASE Ti2O3 AND ITS STRUCTURE	300692
FOUND BY THE LATTICE PARAMETER AND DENSITY METHOD	300692
ACTA CRYST 15, 404 (1962)	300692
	300692
STRAUSS, S	201065
(U S NAVAL RESEARCH LAB WASHINGTON DC)	201065
THE SURFACE TENSIONS OF LIQUID METALS AT THEIR MELTING POINTS	201065
NUCLEAR SCI AND ENG 8, 362 (1960)	201065
CA 55, 16323 (1961)	201065
	201065
STREKALOVSKIY, V BESSONOV, A	400613

PHASE TRANSFORMATIONS DURING REDUCTION AND OXIDATION OF URANIUM OXIDES FIZ METAL I METALLOV 11, 3, 400 (1961)	400613 400613 400613
STREKALOVSKI, V VLASOV, V KINETICS OF REDUCTION OF URANIUM TRIOXIDE WITH HYDROGEN ZHUR PRIKLAD KHIM 34, 32 (1961) CA 55, 17166 (1961)	201079 201079 201079 201079
STRELETS, V PITAK, N KULIK, A LOGACHEV, M LABORATORY STUDIES OF THE TECHNOLOGY OF ZIRCONIUM ARTICLES OGNEUPORY 27, NO 6, 283 (1962)	300624 300624 300624
STRIGANOV, A KATULIN, V ELISEEV, V PECULIARITIES OF THE ISOTOPIC SHIFT IN THE SAMARIUM SPECTRUM OPTICS AND SPECTROSCOPY (USSR) 12, 91 (1962) NSA 16, 19513 (1962)	601468 601468 601468 601468
STRIGANOV, A KOROSTYLEVA, L ISOTOPE EFFECT IN THE URANIUM SPECTRUM ZHUR EKSPIT I TEORET FIZ 29, 393 (1955) CA 50, 3077 (1956)	600989 600989 600989 600989
STRINGER, J OXIDATION OF TITANIUM IN OXYGEN AT HIGH TEMPERATURES ACTA METALLURGICA 8, 758 (1960)	700559 700559 700559
STRONG, H GE RESEARCH LAB SCHENECTADY N Y) MELTING AND OTHER PHASE TRANSFORMATIONS AT HIGH PRESSURE PROC INTERN CONF (NEW YORK) 189 (1961) CA 58, 7685 (1963)	301599 301599 301599 301599 301599
STRUAT, K WEIK, H WRIGHT AIR DEVELOP DIV DAYTON OHIO) YTTRIUM, SCANDIUM AND THE RARE EARTHS SURVEY OVER THE STATE OF THEIR INVESTIGATION METALL 14, 713 (1960) CA 54, 20754 (1960)	601167 601167 601167 601167 601167 601167
STUDIER, M ARGONNE NATL LABS ARGONNE ILL) GASEOUS OXIDES OF RHENIUM J PHYS CHEM 66, 189 (1962) CA 57, 2861 (1962)	201608 201608 201608 201608 201608
STUKENBROEKER, G MCNALLY, J ISOTOPE SHIFTS IN THORIUM-TH230 AND TH232 AECD-2939, (1950) NSA 4, 6588 (1950)	601383 601383 601383 601383
STURCKEN, E POST, B LEI DU PONT DE NEMOURS ET CO AIKEN N C) THE ATOMIC POSITION PARAMETER IN ALPHA-URANIUM ACTA CRYST 13, 852 (1960) CA 55, 5078 (1961)	200857 200857 200857 200857 200857
SUDO, K KIGOSHI, A TOHOKU UNIV SENDAI JAPAN) FUNDAMENTAL STUDIES ON URANIUM DIOXIDES II. EQUILIBRIA AMONG UO2, U4O9, AND U3O8 AT 500 TO 1200 DEGREES SCI PEPT RES INST TOHOKU UNIV SER A13, 448 (1961) CA 56, 13912 (1962)	201530 201530 201530 201530 201530 201530

SUGIYAMA, M SUZUKI, H	300331
SOME PROPERTIES OF TIC-NI CERMET AFFECTED BY FREE CARBON	300331
CONTENTS IN TIC POWDERS	300331
NIPPON KINZOKU GAKKAI SHI 25, 321 (1961)	300331
BHT 4, 21 (1961)	300331
SUITER, J	201042
PROPERTIES OF TITANIUM-NI OBIUM ALLOYS	201042
BULL INST METALS 4, 104 (1958)	201042
CA 55, 14258 (1961)	201042
SUKHAREVSKII, B VISHNEVSKII, I	301159
(UKR REFR MATER SCI RES INST SSSR)	301159
POLYMORPHIC TRANSFORMATION KINETICS OF ZR02	301159
DOKL AKAD NAUK SSSR 147, (4) 882 (1962)	301159
BHT NO 1, 37 (1963)	301159
SULLIVAN, R SEIBEL, R LUNDIN, C	701038
(DENVER UNIV DEN RES INST DENVER COLO)	701038
LITERATURE SURVEY OF SELECTED SEMICONDUCTOR PROPERTIES	701038
AFCRL-4 SCIENTIFIC REPT NO 1 (1960)	701038
NSA 15, 18478 (1961)	701038
SUN, H WEISSLER, G	600725
(UNIV OF S CALIF LOS ANGELES CALIF)	600725
ABSORPTION CROSS SECTIONS OF CARBON DIOXIDE AND CARBON	600725
MONOXIDE IN THE VACUUM ULTRAVIOLET	600725
J CHEM PHYS 23, 1625 (1955)	600725
CA 50, 674 (1956)	600725
SUNDARAM, S	301365
THERMODYNAMIC FUNCTIONS OF SOME PROPELLANTS	301365
Z PHYSIK CHEMIE 36, 376 (1963)	301365
SUSHKOV, V	200815
TEKHNICHESKAYA TERMODINAMIKA	200815
MOSCOW GOSUDARST ENERGET IZDATEL (1960)	200815
CA 55, 2266 (1961)	200815
SUTCLIFFE, L WALSH, A	600732
(UNIV LEEDS ENGLAND)	600732
THE ULTRAVIOLET ABSORPTION SPECTRUM OF NITRIC OXIDE	600732
PROC PHYS SOC 66, 209 (1953)	600732
CA 47, 9145 (1953)	600732
SUTTON, A EELES, W PRICE, A	301600
(ATOMIC ENERGY RES ESTAB HARWELL ENGLAND)	301600
INTERATOMIC DISTANCE IN ALPHA-U AT 20 DEGREES AND 630	301600
DEGREES	301600
REPT R 3818, 45 (1962)	301600
CA 58, 7448 (1963)	301600
SUWA, S	100190
(INST OF SCIENCE TECH TOKYO JAPAN)	100190
HYPERFINE STRUCTURE OF THE SPECTRUM OF GADOLINIUM	100190
J PHYS SOC JAPAN 8, 377 (1953)	100190
CA 47, 10345 (1953)	100190
SUWA, S	400575
(INST OF SCIENCE TECH TOKYO JAPAN)	400575
HYPERFINE STRUCTURES OF THE SPECTRA OF GD AND ZR	400575
PHYS REV 86, 247 (1952)	400575

CA 46, 5963 (1952)	400575
SUZUKI, A KOTERA, Y	201838
(GOVT CHEM IND RES INST TOKYO JAPAN)	201838
KINETICS OF THE TRANSITION OF TITANIUM DIOXIDE	201838
BULL CHEM SOC JAPAN 35, 1353 (1962)	201838
CA 57, 11901 (1962)	201838
SVECHNIKOV, V	301601
CHROMIUM POLYMORPHISM	301601
FIZ MET I METALLOVED 15, NO 4, 616 (1963)	301601
CA 59, 6087 (1963)	301601
SVECHNIKOV, V KOBZENKO, G	201496
THE TERNARY SYSTEM CHROMIUM-NI0BIUM-MOLYBDENUM	201496
SB NAUCHN RABOT INST METALLOFIZ AKAD	201496
NAUK UKR SSR 1961, NO 13, 115	201496
CA 56, 12632 (1962)	201496
SVECHNIKOV, V PAN, V	201495
PHASE DIAGRAM OF CR-NI-NB	201495
DOPVIDI AKAD NAUK UKR RSR 1961, 1290	201495
CA 56, 12628 (1962)	201495
SWABODA, P ARTHUR, P COX, N INGHAM, J OPPERGARD, A	700524
SADLER, M	700524
SYNTHESIS AND PROPERTIES OF FERROMAGNETIC CHROMIUM OXIDE	700524
J APP PHYS 32, 374 (1961)	700524
SWALIN, R	300703
THERMODYNAMICS OF SOLIDS	300703
JOHN WILEY 343 (1962)	300703
SWEENEY, W SEAL, R BIRKS, L	201112
(US NAVAL RESEARCH LAB WASHINGTON DC)	201112
X-RAY MASS ABSORPTION COEFFICIENTS FOR MO, NB, ZR, AND TI	201112
REPT NRL PROGR MARCH 1961, 17 (1961)	201112
CA 55, 18287 (1961)	201112
SWARTS, E	601109
(KNOLLS AT POWER LAB SCHENECTADY NEW YORK)	601109
ACTION OF MOLTEN URANIUM ON GRAPHITE	601109
U S ATOMIC ENERGY COMM KAPL-1765, 23 (1957)	601109
CA 52, 1829 (1958)	601109
SYRE, R	201579
NI0BIUM, MOLYBDENUM, TANTALUM, AND TUNGSTEN. A SUMMARY OF	201579
THEIR PROPERTIES WITH RECOMMENDATIONS FOR RESEARCH AND	201579
DEVELOPMENT	201579
AGARDOGRAPH 50, (1961)	201579
CA 57, 520 (1962)	201579
SZABO, Z LAKATOS, B	601673
(UNIV SZEGED HUNGARY)	601673
REMARKS ON THE MELTING POINT OF TECHNETIUM AND THE PERIODICITY	601673
OF THE MELTING POINTS OF THE TRANSITION METALS	601673
J INST METALS 91, 117 (1962)	601673
BHT NO 4, (1962)	601673
TABACHENKO, A	900227
CALCULATION OF THERMODYNAMIC PROPERTIES OF REAL GASES AT HIGH	900227
TEMPERATURES	900227

INZHENERNO FIZ ZHUR 5, NO 9, 25 (1962)	900227
FTD-TT-63-85	900227
TAGAWA, H FUJIMORI, K	201379
(NIPPON CARBIDE UOZU JAPAN)	201379
CRYSTALLINE STATE OF CALCIUM CARBIDE	201379
KOGYO KAGAKU ZASSHI 63, 1154 (1960)	201379
CA 56, 8104 (1962)	201379
TAGAWA, H ITOUJI, O	201935
(NIPPON CARBIDE IND CO INC TOYAMA JAPAN)	201935
FORMATION AND CRYSTALLINE NATURE OF BORON NITRIDE IN THE	201935
REACTION OF BORON OXIDE WITH SODIUM AMIDE	201935
BULL CHEM SOC JAPAN 35, 1536 (1962)	201935
CA 57, 16113 (1962)	201935
TAGAWA, H SUGAWARA, H	201839
(NIPPON CARBIDE INDUST CO UOZU JAPAN)	201839
THE KINETICS OF THE FORMATION OF CALCIUM CARBIDE IN A SOLID-	201839
SOLID REACTION	201839
BULL CHEM SOC JAPAN 35, 1276 (1962)	201839
CA 57, 11901 (1962)	201839
TAI, S YASINSKA, G SAMSONOV, G	300272
(ACAD SCIENCE UKRAINE USSR)	300272
INTERACTION OF CHROMIUM BORIDE WITH MOLYBDENUM	300272
DOPROVIDI AKAD NAUK UKR RSR NO 1, 48 (1960)	300272
NSA 14, 19452 (1960)	300272
TAKADA, Y IMOTO, S SANJO, T	201937
(UNIV OSAKA OSAKA JAPAN)	201937
PRODUCTION OF URANIUM CARBIDE III SYNTHESIS OF URANIUM	201937
DICARBIDE	201937
NIPPON GENSHIRYOKU GAKKAISHI 3, 513 (1961)	201937
CA 57, 16116 (1962)	201937
TAKEHIKO, I SHIN-YA, O	400552
STRUCTURE OF THE FN ELECTRON CONFIGURATIONS. I. COEFFICIENTS	400552
OF FRACTIONAL PERCENTAGE OF F3. II. SPIN-ORBIT INTERACTION OF	400552
THE CONFIGURATION F3	400552
J PHYS SOC JAPAN 5, 145 (1950)	400552
CA 45, 1863 (1951)	400552
TAKEKAZU, B HIROTA, E	201549
(MATSUSHITA ELEC IND CO OSAKA JAPAN)	201549
THE PREPARATION AND PROPERTIES OF CHROMIUM OXIDES	201549
NATL TECH REPT 7, 372 (1961)	201549
CA 56, 15113 (1962)	201549
TALLEY, C POST, B LAPLACA, S	200993
(EXPT INC RICHMOND VA)	200993
A NEW MODIFICATION OF ELEMENTAL BORON	200993
BORON SYNTHESIS STRUCTURE PROPERTIES PROC CONF	200993
ASBURY PARK N J 1959, 83 (1960)	200993
CA 55, 12987 (1961)	200993
TALROZE, V	601643
REACTIONS OF POSITIVE IONS WITH MOLECULES IN GAS PHASE	601643
IN THE RANGE 3×10 TO THE (MINUS 2) POWER -10 TO THE	601643
(PLUS 2) POWER EV	601643
RUSSIAN REPORT, CHEMICAL EFFECTS OF A NUCLEAR TRANSFORMATION,	601643
PROCEEDINGS OF A SYMPOSIUM 1, 103 (1960)	601643
CA 57, 206 (1962)	601643

TANAKA, Y			600563
(TOKYO UNIV	TOKYO	JAPAN)	600563
THE NEW ABSORPTION BANDS OF THE OXYGEN MOLECULE IN THE			600563
FAR ULTRAVIOLET REGION			600563
J CHEM PHYS 20, 1728 (1952)			600563
CA 47, 4733 (1953)			600563
TANAKA, Y			600599
(AIR RES AND DEV COMMAND	CAMBRIDGE	MASS)	600599
ABSORPTION SPECTRUM OF NITROGEN IN THE REGION 1075 TO 1650A			600599
J OPT SOC AMER 45, 663 (1955)			600599
CA 49, 15476 (1955)			600599
TANAKA, Y			600731
(UNIV OF CHICAGO	CHICAGO	ILL)	600731
MIESCHER-BAER EMISSION BANDS IN THE FAR-ULTRAVIOLET REGION			600731
J CHEM PHYS 21, 562 (1953)			600731
CA 47, 9145 (1953)			600731
TANAKA, Y			600756
EMISSION BANDS OF NO IN THE VACUUM ULTRAVIOLET REGION			600756
EXCITED IN THE NO AFTERGLOW			600756
J CHEM PHYS 22, NO 12 2045 (1954)			600756
PA 58, 1691 (1955)			600756
TANAKA, Y			600683
(UNIV OF CHICAGO	CHICAGO	ILL)	600683
THE EMISSION BANDS OF THE NITROGEN OXIDE MOLECULE IN THE			600683
VACUUM ULTRAVIOLET REGION			600683
J CHEM PHYS 21, 788 (1953)			600683
CA 47, 7317 (1953)			600683
TANAKA, Y JURSA, A LEBLANC, F			600564
(AIR FORCE CAMB RES CTR	BEDFORD	MASS)	600564
HOPF'ELDS EMISSION BANDS OF OXYGEN IN THE REGION 1900-2350A			600564
J CHEM PHYS 24, 915 (1956)			600564
CA 50, 98692 (1956)			600564
TANAKA, Y JURSA, A LEBLANC, F			600726
ABSORPTION SPECTRUM OF CARBON MONOXIDE IN THE VACUUM			600726
ULTRAVIOLET REGION			600726
J CHEM PHYS 26, 862 (1957)			600726
CA 51, 11850 (1957)			600726
TANAKA, Y SEYA, M MORI, K			600760
(TOKYO UNIV EDUCATION	TOKYO	JAPAN)	600760
NEW ABSORPTION BANDS OF THE NITRIC OXIDE MOLECULE			600760
IN THE EXTREME ULTRAVIOLET REGION			600760
J CHEM PHYS 19, 979 (1951)			600760
CA 45, 8351 (1951)			600760
TANGRI, K WILLIAMS, G			201308
(FULMER RES INST	STOKE PAGES	ENGLAND)	201308
METASTABLE PHASES IN THE URANIUM-MOLYBDENUM SYSTEM AND THEIR			201308
ORIGIN			201308
J NUCLEAR MATERIALS 4, 226 (1961)			201308
CA 56, 4485 (1962)			201308
TANISAKI, S			201076
(UNIV YAMAGUCHI		JAPAN)	201076
THE PHASE TRANSITION OF TUNGSTEN TRIOXIDE BELOW ROOM TEMP-			201076
ERATURE			201076

J PHYS SOC JAPAN 15, 566 (1960)	201076
CA 55, 17151 (1961)	201076
TANISAKI, S	201077
(UNIV YAMAGUCHI JAPAN)	201077
CRYSTAL STRUCTURE OF MONOCLINIC TUNGSTEN TRIOXIDE AT ROOM	201077
TEMPERATURE	201077
J PHYS SOC JAPAN 15, 573 (1960)	201077
CA 55, 17152 (1961)	201077
TATEVSKII, V KOPTEV, G MALTSEV, A	300384
VIBRATION SPECTRA OF B2O3 AND B2S3 MOLECULES	300384
OPT I SPEKTR 11, NO 6 724 (1961)	300384
RUSS ACC 14, NO 11 2914 (1962)	300384
TAWDE, N MURTHY, N	600913
(UNIV KARNATAK DHARWAR INDIA)	600913
VALIDITY OF THE REVISED ROTATIONAL STRUCTURE CONSTANTS	600913
OF GREEN-YELLOW SYSTEM OF VO BANDS	600913
INDIAN J PHYS 31, 391 (1957)	600913
CA 52, 3513 (1958)	600913
TAWDE, N MURTHY, N HEGDE, S	300782
EFFICACY OF THE PARABOLIC INTERPOLATION TECHNIQUE IN THE	300782
DERIVATION OF MOLECULAR CONSTANTS	300782
INDIAN J PHYSICS 36, NO 1, 25 (1962)	300782
PA 65, 12323 (1962)	300782
TAYLOR, A DOYLE, N KAGLE, B	201207
(WESTINGHOUSE RES LABS PITTSBURGH PA)	201207
THE CONSTITUTION DIAGRAM OF THE MOLYBDENUM-HAFNIUM	201207
BINARY SYSTEM	201207
J LESS-COMMON METALS 3, 265 (1961)	201207
CA 56, 248 (1962)	201207
TAYLOR, A DOYLE, N KAGLE, B	201206
(WESTINGHOUSE RES LABS PITTSBURGH PA)	201206
THE CONSTITUTION DIAGRAM OF THE TUNGSTEN-OSMIUM	201206
BINARY SYSTEM	201206
J LESS-COMMON METALS 3, 333 (1961)	201206
CA 56, 247 (1962)	201206
TAYLOR, R	201288
(NORTH AM AVIATION CANOGA PARK CALIFORNIA)	201288
THERMAL CONDUCTIVITY OF TITANIUM CARBIDE AT HIGH TEMPERATURES	201288
J AM CERAM SOC 44, 525 (1961)	201288
CA 56, 4114 (1962)	201288
TAYLOR, A DOYLE, N KAGLE, B	600833
THE CONSTITUTION DIAGRAM OF THE MOLYBDENUM HAFNIUM BINARY	600833
SYSTEM	600833
J LESS-COMMON METALS 3, 265 (1961)	600833
TAYLOR, A KAGLE, B DOYLE, N	301000
THE CONSTITUTION DIAGRAM OF THE RHENIUM-HAFNIUM SYSTEM	301000
J LESS COMMON METAL 5, NO 1, 41 (1963)	301000
TAYLOR, A DOYLE, N KAGLE, B	301026
(WESTINGHOUSE RES LABS PITTSBURGH PA)	301026
THE CONSTITUTION DIAGRAM OF THE SYSTEM MOLYBDENUM-OSMIUM	301026
J LESS-COMMON METALS 4, 436 (1962)	301026
CA 58, 5333 (1963)	301026

TAYLOR, A JONES, R		200776	
(WEST HOUSE RES LABS	PITTSBURGH	PENNA)	200776
CRYSTAL STRUCTURE AND THERMAL EXPANSION OF CUBIC AND			200776
HEXAGONAL SILICON CARBIDE			200776
SILICON CARBIDE, PROC CONF, BOSTON 1959, 147 (1960)			200776
CA 55, 6977 (1961)			200776
TAYLOR, A RYDEN, H		301027	
(WESTINGHOUSE RES LABS	PITTSBURGH	PA)	301027
A TUNGSTEN TUBE MELTING POINT AND SPECIMEN ANNEALING FURNACE			301027
J LESS COMMON METALS 4, 451 (1962)			301027
CA 58, 5329 (1963)			301027
TAYLOR, M SMITH, C		201675	
(AT ENERGY RES ESTAB	HARWELL	ENGLAND)	201675
THE ELECTRICAL RESISTIVITY OF VANADIUM AND VANADIUM-CHROMIUM			201675
SOLID SOLUTIONS			201675
PHYSICA 28, 453 (1962)			201675
CA 57, 4144 (1962)			201675
TAYLOR, R		200793	
(ATOMICS INTERN	CANOGA PARK	CALIF)	200793
THERMAL CONDUCTIVITY AND THERMAL EXPANSION OF BEO			200793
AT ELEVATED TEMPERATURES			200793
US ATOMIC ENERGY COMM NAA-SR-4905, (1960)			200793
CA 55, 1117 (1961)			200793
TAYLOR, R FINCH, R		201250	
THE SPECIFIC HEATS AND RESISTIVITIES OF MO, TA AND RE			201250
FROM LOW TO VERY HIGH TEMPERATURES			201250
US AT ENERGY COMM NAA-SR-6034 (1961)			201250
CA 56, 2046 (1962)			201250
TAYLOR, R		300694	
THERMAL CONDUCTIVITY OF ZIRCONIUM CARBIDE AT HIGH			300694
TEMPERATURES			300694
J AM CERAM SOC 45, NO 7, 353 (1962)			300694
TAYLOR, W ET AL		301602	
(OHIO STATE UNIV RES FOUND		OHIO)	301602
ELECTRICAL PROPERTIES OF HIGH-PURITY BORON			301602
REPORT RF 829			301602
AFOSR-1177			301602
AD 265266			301602
TCHENG, M		400584	
RARE EARTH AND OTHER ELEMENTS FROM ASTRONOMICAL OBSERVATION OF			400584
STAR X CYGNI			400584
COMPT REND 229, 1301 (1949)			400584
CA 44, 3989 (1950)			400584
TCHENG, M		400585	
THE SPECTRUM OF X CYGNI SHORTLY BEFORE ITS 1948 MAXIMUM			400585
ANN ASTROPHYSICS 13, 57 (1950)			400585
CA 44, 9797 (1950)			400585
TELLER, E		300999	
(UNIV OF CAL	BERKELEY	CAL)	300999
ON THE STABILITY OF MOLECULES IN THE THOMAS-FERMI THEORY			300999
REV MODERN PHYSICS 34, 627 (1962)			300999
TEUFER, G		301604	
(DUPONT	WILMINGTON	DEL)	301604

THE CRYSTAL STRUCTURE OF TETRAGONAL ZR02 ACTA CRYST 15, NO 11, 1187 (1962) CA 59, 5879 (1963)	301604 301604 301604
TEMPLETON, D DAWKEN, C (UNIV OF CALIF BERKLEY CALIF) LATTICE PARAMETERS OF SOME RARE EARTH COMPOUNDS AND A SET OF CRYSTAL RADII J AM CHEM SOC 76, 5273 (1954) CA 49, 1399 (1953)	600938 600938 600938 600938 600938 600938
TENNERY, J (OAK RIDGE NATL LAB OAK RIDGE TENN) REVIEW OF THERMAL CONDUCTIVITY AND HEAT TRANSFER IN UO2 ORNL-2656 (1959) NSA 13, 11870 (1959)	601535 601535 601535 601535 601535
TERAO, N (UNION CARBIDE EUROPE RES BRUXELLES BELGIUM) STRUCTURES OF NIOBIUM OXIDES J APPL PHYS (JAPAN) 2, 156 (1963) CA 58, 12031 (1963)	301603 301603 301603 301603 301603
TEREKHOVA, V SAVITSKII, E INTERACTION OF RARE-EARTH METALS WITH MG, FE, CR, AND TI. REDKIE METALLY I SPLAVY, TRUDY PERVOGO VSESUYUZ SOVESHCHANIYA PO SPLAVAM REDKIKH METAL., AKAD NAUK SSSR INST MET IM AA BAIKOVA, MOSCOW 1957, 189 (1960) CA 55, 3357 (1961)	200833 200833 200833 200833 200833 200833 200833
TESKE, R (PERKINS OBSERVATORY DELEWARE OHIO) THE RED SPECTRUM OF FU MONOCEROTIS PUBLASTRON SOC PACIFIC 68, 520 (1956) CA 51, 4815 (1957)	601043 601043 601043 601043 601043
TETEREVKOV, A VILNYANSKII, Y CHLORINATION OF MAGNESIUM OXIDE IN MOLTEN CARNALLITE TRUDY URAL POLITEKH INST IM SM KIROVA 1959, NO 81, 144 (1959) CA 55, 13222 (1961)	201008 201008 201008 201008
THEWLIS, J X-RAY POWDER STUDY OF BETA-URANIUM ACTA CRYST 5, 790 (1952) CA 47, 3077 (1953) NSA 7, 783 (1953)	100202 100202 100202 100202 100202
THEWLIS, J STRUCTURE OF URANIUM NATURE 168, 198 (1951) CA 46, 7423 (1952) NSA 6, 121 (1952).	400569 400569 400569 400569 400569
THEWLIS, J STEEPLE, H THE BETA URANIUM STRUCTURE ACTA CRYST 7, 323 (1954)	601650 601650 601650
THIELEMANN, R (SIERRA METALS CORP HIGH-TEMPERATURE TANTALUM-NIOBIUM ALLOYS US PATENT 2907654 (1959) CA 54, 1241 (1960)	500127 500127 500127 500127 500127

THOMAS, J WESTON, N OCONNOR, T	301039
(E I DU PONT DE NEMOURS + CO WILMINGTON DEL)	301039
TURBOSTRATIC BORON NITRIDE, THERMAL TRANSFORMATION TO ORDERED-	301039
LAYER-LATTICE BORON NITRIDE	301039
J AM CHEM SOC 84, 4619 (1962)	301039
CA 58, 5111 (1963)	301039
THOMPSON, A HOLTON, W KREMERS, H	700828
PREPARATION AND SOME PROPERTIES OF METALLIC YTTRIUM	700828
TRANS ELECTROCHEM SOC 49, 277 (1926)	700828
THOMPSON, C SINKE, G STULL, D	201817
(DOW CHEM CO MIDLAND MICH)	201817
HEAT OF FORMATION OF BERYLLIUM CHLORIDE	201817
J CHEM ENG DATA 7, 380 (1962)	201817
CA 57, 10591 (1962)	201817
THOMPSON, H GREEN, B	600761
(PHYS CHEM LAB OXFORD ENGLAND)	600761
FUNDAMENTAL VIBRATION BAND OF NITRIC OXIDE	600761
SPECTROCHIM ACTA 8, 129 (1956)	600761
CA 51, 78 (1957)	600761
THOMPSON, R	201058
(UNIV OF TEXAS AUSTIN TEXAS)	201058
LOWER OXIDATION STATE STUDIES-COBALT AND RHENIUM	201058
UNIV MICROFILMS (ANN ARBOR MICH) LC CARD NO MIC 60-6652	201058
DISSERTATION ABSTR 21, 2468 (1961)	201058
CA 55, 16239 (1961)	201058
THOMPSON, R	202146
REFRACTORY BORIDES	202146
TRANS INST CHEM ENGRS (LONDON) 41, 51 (1963)	202146
THOMSON, J	201648
(IMP COLL SCI TECHNOL LONDON ENGLAND)	201648
CRYSTAL STRUCTURES OF THRH ₂ , THRU, AND THIR	201648
NATURE 194, 465 (1962)	201648
CA 57, 4125 (1962)	201648
THRUSH, B	200961
(DEPT OF PHYSICAL CHEM CAMBRIDGE ENGLAND)	200961
THE GROUND STATE OF BERYLLIUM OXIDE	200961
PROC CHEM SOC 1960, 339	200961
CA 55, 11070 (1961)	200961
TIDWELL, E PLYLER, E BENEDICT, W	600921
VIBRATION-ROTATION BANDS OF N ₂ O	600921
J OPT SOC AM 50, NO 12 1243 (1960)	600921
PA 64, 832 (1961)	600921
TIMOFEEVICHEVA, O LAZAREV, V	300540
THE SURFACE TENSION AND STRUCTURE OF LIQUID METALS	300540
IZV AKAD NAUK SSSR OTD TEKH NAUK MET I TOPLIVO NO 3, 147	300540
(1961)	300540
BHT NO 2, 36 (1962)	300540
TISZA, L	700592
THERMODYNAMICS OF PHASE EQUILIBRIUM	700592
ANN PHYS NY 13, 1 (1961)	700592
TITOVA, V FUTERGENDLER, S	301040

ORIENTATION OF THE GRAPHITE WHICH IS FORMED ON THE DIAMOND SURFACE AS A RESULT OF ITS ALLOTROPIC TRANSFORMATION ON HEATING	301040
KRISTALLOGRAFIJA 7, 926 (1962)	301040
CA 58, 5110 (1963)	301040
TKACHENKO, E V VLASOV, V G	301605
PHASE TRANSFORMATIONS DURING REDUCTION OF URANIUM OXIDES WITH SOLID CARBON	301605
FIZ METAL I METALLOVED 15, NO 2, 239 (1963)	301605
CA 58, 12253H (1963)	301605
TØBIAS, I FALLON, R VANDERSLICE, J	600695
POTENTIAL ENERGY CURVES FOR CO	600695
J CHEM PHYS 33, NO 6, 1638 (1960)	600695
PA 64, 2333 (1961)	600695
TØENNIES, J GREENE, E	600600
(BROWN UNIV PROVIDENCE R I)	600600
DISSOCIATION ENERGIES OF CARBON MONOXIDE AND NITROGEN FROM REFLECTED SHOCK WAVE STUDIES	600600
J CHEM PHYS 26, 655 (1957)	600600
CA 51, 10987 (1957)	600600
TØGURI, J	201009
THE THERMAL REDUCTION OF MAGNESIUM OXIDE	201009
TIDSSKR KJEMI BERGVESEN MET 20, 211 (1960)	201009
CA 55, 13223 (1961)	201009
TØMITA, T	600801
(SAITAMA UNIV URAWA)	600801
CRYSTAL STRUCTURE OF SILICON CARBIDE OF 174 LAYERS	600801
J CHEM SOC JAPAN 15, 99 (1960)	600801
CA 55, 16066 (1961)	600801
TØPCHIASHVILI, L	201238
SOLUBILITY OF ELEMENTS IN MN	201238
TRUDY INST PRIKLAD KHIM I ELEKTROCHEM AKAD	201238
NAUK GRUZIN SSR 1, 51 (1960)	201238
CA 56, 1255 (1962)	201238
TØRESSON, Y	200804
(UNIV LUND SWEDEN)	200804
SPECTRUM AND TERM SYSTEM OF TREBLY IONIZED SILICON, SI IV	200804
ARKIV FYSIK 17, 179 (1960)	200804
CA 55, 1178 (1961)	200804
TØRØPØV, N BONDAR, I	201506
SILICATES OF RARE EARTH ELEMENTS. I. PHASE DIAGRAM FOR THE LANTHANUM OXIDE-SILICA SYSTEM	201506
Izv Akad Nauk SSSR Otd Khim Nauk 1960, 153	201506
CA 56, 13603 (1962)	201506
TØRØPØV, N GALAKHOV, F KONOVALOVA, S	201965
SILICATES OF THE RARE EARTH ELEMENTS II PHASE DIAGRAM FOR THE BINARY SYSTEM GADOLINIUM OXIDE-SILICA	201965
Izv Akad Nauk SSSR Otd Khim Nauk 1961, 539 (1961)	201965
CA 58, 967 (1963)	201965
TØSIM, S MILNE, T	601505
BASIC CHEMISTRY OF HIGH TEMPERATURE INORGANIC SYSTEMS	601505
NAA-SR-2124 (1957)	601505
NSA 12, 4073 (1958)	601505

TOTH, L BENESOVSKY, F NOWOTNY, H RUDY, E (UNIV VIENNA VIENNA AUSTRIA) THE TERNARY SYSTEM THORIUM-BORON-CARBON MONATSH CHEM 92, 956 (1961) CA 56, 10979 (1962)	201446 201446 201446 201446 201446
TOTH, L NOWOTNY, H BENESOVSKY, F RUDY, E (UNIV VIENNA VIENNA AUSTRIA) THE SYSTEM U-B-C MONATSH 92, 794 (1961) CA 56, 2064 (1962)	201256 201256 201256 201256 201256
TOTH, L NOWOTNY, H BENESOVSKY, F RUDY, E (UNIV VIENNA VIENNA AUSTRIA) THE SYSTEM THORIUM-URANIUM-BORON MONATSH CHEM 92, 945 (1961) CA 56, 9478 (1962)	201405 201405 201405 201405 201405
TRAJMAR, S (UCLRL BERKELEY CAL) STUDY OF THE NEAR-ULTRA-VIOLET SPECTRUM OF MAGNESIUM OXIDE UCRL-9773 (1961) NSA 15, 27512 (1961)	700962 700962 700962 700962 700962
TREES, R (NBS WASHINGTON D C) LOW EVEN CONFIGURATIONS IN THE FIRST SPECTRUM OF THORIUM PHYSICA (NETHERLANDS) 26, NO 5 353 (1960) NSA 16, 18302 (1960) PA 64, 5977 (1961)	600852 600852 600852 600852 600852 600852
TREES, R (NBS WASHINGTON DC) REPU_SION OF ENERGY LEVELS IN COMPLEX ATOMIC SPECTRA PHYS REV 123, 1293 (1961) NSA 15, 28207 (1961)	701067 701067 701067 701067 701067
TRETYACHENKO, G KRAVCHUK, L A METHOD FOR DETERMINING THE THERMOPHYSICAL CHARACTERISTICS OF MATERIALS AT HIGH TEMPERATURES TEZISY DOKLADOV I' SOBSHCHENIY NA SOVESHCHANII PO TEPLU-I MASSOBMENU, MINSK, AK NAUK BELORUSSKOY SSR (1961)	400610 400610 400610 400610 400610 400610
TRESVYATSKIY, S CHEREPANOV, A HIGH HEAT-RESISTANT SYSTEMS WITH OXIDES OF LANTHANUM AND ACTINIUM ZHUR VSES KHIM OSHCH IMENI D I MENDELEYEV 6, NO6, 612 (1961) COTS NO 52, 169 (1962)	300440 300440 300440 300440 300440
TRIBALAT, S JUNGFLEISCH, M COLLET, V PREPARATION OF OXIDES AND SULFIDES OF RE AND THEIR X-RAY ABSORPTION SPECTRA COMPT REND 251, 718 (1960) CA 55, 3257 (1961)	200829 200829 200829 200829 200829
TROMBE, F FOEX, M SEPARATION OF NEODYMIUM AND PRASEODYMIUM BY DISTILLATION OF THEIR OXIDES AT HIGH TEMPERATURE IN A SOLAR FURNACE COMPT REND 255, 1516 (1962) CA 58, 263E (1963)	301367 301367 301367 301367 301367

TRØITSKAYA, N PINSKER, Z	200858
CUBIC MØLYBDENUM NITRIDE	200858
KRISTALLØGRAFIYA 4, 38 (1959)	200858
CA 55, 5078 (1961)	200858
TRØITSKAYA, N PINSKER, Z	202147
ELECTRON DIFFRACTION STUDY ØF THE SUPERSTRUCTURE ØF	202147
MØLYBDENUM NITRIDE	202147
KRISTALLØGRAFIYA 8 548 (1963)	202147
TRØITSKAYA, N PINSKER, Z	700601
THE HEXAGONAL NITRIDES ØF MØLYBDENUM	700601
KRISTALLØGRAFIYA 6, 43 (1961)	700601
PA 65, 4416 (1962)	700601
TRØJER, F	201929
CRYSTAL PHASES T12Ø3 AND T13Ø5	201929
RADEX RUNDSCHAU 1962, 212 (1962)	201929
CA 57, 15909 (1962)	201929
TRØMBE, F	600960
THE VAPØR PRESSURES ØF THE RARE EARTH METALS. THEIR SEPARATION	600960
AND PURIFICATION	600960
BULL SOC CHEM (FRANCE) 1010 (1953)	600960
CA 48, 5011 (1954)	600960
NSA 8, 6122 (1954)	600960
TRØMBE, F FØEX, M	900118
INST CHIMIE PARIS FRANCE)	900118
RANGE ØF EXISTENCE AND PRØPERTIES ØF THE ALLØTROPIC STATES ØF	900118
METALLIC CERIUM	900118
ANN CHIM 19, 417 (1944)	900118
CA 40, 3955 (1946)	900118
TRØMBE, F FØEX, M	400546
DILATØMETRIC STUDY ØF METALLIC NEODYMIUM	400546
COMPT REND 232, 63 (1951)	400546
CA 45, 5988 (1951)	400546
NSA 5, 2967 (1951)	400546
TRØMEL, G KRISEMENT, Ø	700690
ALPHA-BETA INVERSION ØF CRISTØBALITE	700690
TØNIND-ZTG U KERAM RUNDSCHAU 83, NØ 6, 118 (1959)	700690
CERAM A 44, 183H (1961)	700690
TRØNEVA, N MARCHUKØVA, I BØRØVSKII, I	601157
IMØSCØW STATE U MOSCØW USSR)	601157
X-RAY L-SPECTRA ØF CERIUM IN CEB6 AND CEØ2	601157
FIZ METAL I METALLØVED 6, 141 (1958)	601157
CA 53, 12821 (1959)	601157
TRULSØN, Ø	601211
IØWA STATE UNIV AMES IØWA)	601211
COHESIVE ENERGIES ØF SOME RARE EARTH METALS	601211
UNIV MICROFILMS MIC 59-3392,	601211
DISSERTATION ABSTR 20, 1049 (1959)	601211
CA 54, 1960 (1960)	601211
TRULSØN, Ø HUDSØN, D SPEDDING, F	600832
COHESIVE ENERGIES ØF GADØLINIUM, HØLMIUM, ERBIUM	600832
J CHEM PHYS 35, 1018 (1961)	600832
TRUNØV, V KØVBA, L SPITSYN, I	201485

(MV LOMONOSOV STATE UNIV	MOSCOW	RUSSIA)	201485
DOUBLE OXIDES OF THE URANIUM-TUNGSTEN-OXYGEN SYSTEM			201485
DOKL AKAD NAUK SSSR 141, 114 (1961)			201485
CA 56, 12519 (1962)			201485
TRZEBIATOWSKI, W	RUDZINSKI, J		201857
(INST CHEM TECH HOCHSCHULE	WR0CLAW	POLAND)	201857
TECHNETIUM CARBIDE			201857
Z CHEM 2, 158 (1962)			201857
CA 57, 12095 (1962)			201857
TSAREV, B M	ILLARI0N0V, S V		301369
OPTICAL CONSTANTS OF LAB6 AND CEB6			301369
COTS 66, 251 (1963)			301369
TSAREV, B	KUDINTSEVA, G		301161
BORIDES OF TRANSITION METALS AND THEIR ELECTRON-EMISSION			301161
PROPERTIES			301161
KONFERENTSIY PO KHIMII B0RA I YEG0 S0YEDINENIY,			301161
M0SK0W 106 (1958)			301161
COTS, 105, MARCH 1963			301161
TSENG-CHI, H	P0LYAK0V, A	SAMARIN, A	301003
THERMODYNAMICS OF CARBON IN MOLTEN IRON			301003
FIZ KHIM 0SN0VY PR0IZV STALI, AKAD NAUK SSSR INST MET			301003
TR FIFTH KONF 1959, 112 (1961)			301003
CA 58, 1161 (1963)			301003
TSEPLYAEVA, A	PRISELK0V, Y	KARELIN, V	300400
THE MEASUREMENT OF THE SATURATED VAPOR PRESSURE OF SILICON			300400
VESTNIK M0SK0V U SER 11 15, N0 5 36 (1960)			300400
CA 55, 25400 (1961)			300400
TSERTSVADZE, A	TCHKHARTISHVILI, U	KATCHLISHVILI, Z	300583
CALCULATION OF IONIC AND ATOMIC CONTRIBUTION IN			300583
BONDING IN SILICON CARBIDE CRYSTALS			300583
FIZ TVERD TELA 4, N0 7, 1743 (1962)			300583
CT N0 17, 79 (1962)			300583
TSIRELNIK0V, V	K0MISSAR0VA, L	SPITSYN, V	301101
THE THERMAL CONDUCTIVITY AND VISCOSITY OF ZIRCONIUM AND			301101
HAFNIUM TETRACHLORIDE VAPORS OVER THE TEMPERATURE INTERVAL			301101
300-700 C			301101
DOK AKAD NAUK SSSR 139, 1389 (1961)			301101
COTS 54, 290 (1962)			301101
TSUB01, M	TERADA, M	SHIMAN0UCHI, T	201721
(UNIV T0KY0	T0KY0	JAPAN)	201721
OPTICALLY ACTIVE LATTICE VIBRATIONS OF ALPHA-URANIUM TRIOXIDE			201721
CA 57, 5482 (1962) J CHEM PHYS 36, 1301 (1962)			201721
TSUJIMURA, S			201985
(AT ENERGY RES INST	T0KAI	JAPAN)	201985
FORMATION AND REDUCTION OF URANIUM HEXAFLUORIDE			201985
K0GY0 KAGAKU ZASSHI 65, 1146 (1962)			201985
CA 58, 2114 (1963)			201985
TSVETAEV, A	GLAZUN0V, M	KISELEV, V	300768
DETERMINATION OF THE ACTIVATION ENERGY OF VAPORIZATION			300768
FROM THE VARIOUS FACES OF A ZINC MONOCRYSTAL			300768
ZHUR FIZ KHIM 35, 2800 (1961)			300768
TUCKER, C			601371

THE CRYSTAL STRUCTURES OF METALLIC URANIUM	601371
AECD 2716 (1949)	601371
NSA 3, 2158 (1949)	601371
TUCKER, C	400570
(KNOLLS AT POWER LAB SCHENECTADY NEW YORK)	400570
A CORRECTION AND NOTE ON THE RELATION OF THE BETA URANIUM	400570
AND SIGMA PHASE STRUCTURES	400570
ACTA CRYST 5, 389 (1952)	400570
CA 46, 7390 (1952)	400570
TUCKER, C	400571
(KNOLLS AT POWER LAB SCHENECTADY NEW YORK)	400571
A SUPPLEMENTARY NOTE ON THE CRYSTAL STRUCTURES OF BETA URANIUM	400571
ACTA CRYST 5, 395 (1952)	400571
CA 46, 7390 (1952)	400571
TUCKER, C	600673
A SUPPLEMENTARY NOTE ON THE CRYSTAL STRUCTURE OF BETA URANIUM	600673
AECU-1807	600673
NSA 6, 1183 (1952)	600673
TUCKER, C	601176
AN APPROXIMATE CRYSTAL STRUCTURE FOR THE BETA PHASE OF	601176
URANIUM	601176
AECD-2957 KAPL-388 (1950)	601176
ACTA CRYST 4, 425 (1951)	601176
NSA 5, 1806 (1951)	601176
NSA 5, 6800 (1951)	601176
TUCKER, C SENIO, P THEWLIS, J	601285
(KNOLLS AT POWER LAB SCHENECTADY NY)	601285
THE STATUS OF THE BETA-URANIUM STRUCTURE	601285
ACTA CRYST 7, 752 (1954)	601285
NSA 9, 1209 (1955)	601285
TUCKER, C SENIO, P	600964
(G.E. CO SCHENECTADY N.Y.)	600964
(KNOLLS AT POWER LAB SCHENECTADY NEW YORK)	600964
AN IMPROVED DETERMINATION OF THE CRYSTAL STRUCTURE	600964
OF BETA-URANIUM	600964
ACTA CRYST 6, 753 (1953)	600964
CA 48, 1766 (1954)	600964
NSA 8, 1605 (1954)	600964
TUCKER, C SENIO, P THEWLIS, J STEEPLE, H	601016
(GENERAL ELECTRIC SCHENECTADY NEW YORK)	601016
JOINT NOTE ON THE BETA-URANIUM STRUCTURE	601016
ACTA CRYST 9, 472 (1956)	601016
CA 50, 12587 (1956)	601016
TUCKER, C SENIO, P	601251
THE REFINED CRYSTAL STRUCTURE OF BETA-URANIUM	601251
KAPL-844 (1952)	601251
NSA 7, 1856 (1953)	601251
TURNBULL, A	300259
THERMOCHEMISTRY OF ZIRCONIUM HALIDES	300259
J PHYS CHEM 65, NO 9, 1652 (1961)	300259
CA 56, 4164 (1962)	300259
TUXWORTH, R	600849
AN ORIENTATION STUDY OF UO2 SINGLE CRYSTALS	600849

AFCL 1170 (1960)	600849
CA 55, 12987 (1961)	600849
TVØRØGØV, N	700831
(INST ØF RAD, ELEC ACAD ØF SCI USSR)	700831
HEXABØRIDES ØF THE RARE EARTH ELEMENTS AND YTTRIUM	700831
ZHUR NEØRG KHIM 4, 1961 (1959)	700831
CA 54, 11788 (1960)	700831
NSA 14, 1479 (1960)	700831
TYE, R	201117
(NATL PHYS LAB TEDDINGTON ENGLAND)	201117
PRELIMINARY MEASUREMENTS ØN THE THERMAL AND ELECTRICAL CØNDUC-	201117
TIVITIES ØF MØLYBDENUM, NIØBIUM, TANTALUM, AND TUNGSTEN	201117
J LESS-CØMMØN METALS 3, 13 (1961)	201117
CA 55, 18497 (1961)	201117
TYLER, W WILSON, A WØLGA, G	100185
(KNØLLS AT PØWER LAB SCHENECTADY NEW YØRK)	100185
THERMAL CØNDUCTIVITY, ELECTRICAL RESISTIVITY, AND	100185
THERMØELECTRIC PØWER ØF URANIUM	100185
J MET 5, AIME TRANS 197, 1238 (1953)	100185
CA 47, 10937 (1953)	100185
TYLKINA, M PØVARØVA, K	201915
STRUCTURAL DIAGRAMS ØF RHENIUM	201915
RENII TR VSES SØVESHCØ PØ PRØBL RENIYA AKAD NAUK SSSR	201915
INST MET 1958, 127 (1961)	201915
CA 57, 14839 (1962)	201915
TYLKINA, M PØLYAKØVA, V SAVITSKII, E	201729
CØMPØSITIØN DIAGRAM ØF ALLØYS IN THE SYSTEM ØSMIUM-RUTHENIUM	201729
ZH NEØRGAN KHIM 7, 1467 (1962)	201729
CA 57, 5683 (1962)	201729
TYLKINA, M PØLYAKØVA, V SAVITSKII, E	201728
CØMPØSITIØN DIAGRAM ØF ØSMIUM-RHENIUM	201728
ZH NEØRGAN KHIM 7, 1469 (1962)	201728
CA 57, 5683 (1962)	201728
TYLKINA, M PØVARØVA, K SAVITSKII, E	201291
EQUILIBRIUM DIAGRAM ØF THE SYSTEM VANADIUM-RHENIUM	201291
ZHUR NEØRG KHIM 5, 1907 (1960)	201291
CA 56, 4144 (1962)	201291
TYLKINA, M PØLYAKØVA, V SAVITSKII, E	700623
PHASE DIAGRAM ØF THE PALLADIUM-TUNGSTEN SYSTEM	700623
ZHUR NEØRG KHIM 6, 1471 (1961)	700623
CT NØ 13, (1961)	700623
TYLKINA, M PØVARØVA, K SAVITSKII, E	200935
PHASE IN THE RHENIUM-VANADIUM SYSTEM	200935
DØKLADY AKAD NAUK SSSR 131, 332 (1960)	200935
CA 55, 9232 (1961)	200935
TYLKINA, M PØVARØVA, K SAVITSKII, E	201292
TERNARY SØLID SØLUTIØNS IN THE SYSTEM TUNGSTEN-MØLYBDENUM-	201292
RHENIUM	201292
ZHUR NEØRG KHIM 5, 2458 (1960)	201292
CA 56, 4144 (1962)	201292
TYRRELL, M HØUCK, C	202148
(U S BUR ØF MINES NØRRIS TENN)	202148

METALLIC BINDERS FOR ZIRCONIUM DIBORIDE- IRON, COBALT, AND NICKEL	202148 202148
US BUR MINES REPT INVEST NO 6262, (1963)	202148
CA 59, 7206 (1963)	202148
 UEDA, M	 600762
THE ABSORPTION SPECTRUM OF NITRIC OXIDE IN THE FAR ULTRAVIOLET REGION	600762 600762
SCI OF LIGHT (TOKYO) 3, NO 2, 143 (1955)	600762
PA 58, 6912 (1955)	600762
 UHLER, U	 301370
ROTATION ANALYSIS OF THE BLUE BAND SYSTEM OF COLUMBIUM OXIDE	301370
NATURWISSENSCHAFTEN 41, 137 (1954)	301370
CA 49, 2866B (1955)	301370
 UHLER, U	 600915
(UNIV OF STOCKHOLM STOCKHOLM SWEDEN)	600915
THE BLUE BAND-SYSTEM OF NIOBIUM OXIDE	600915
ARKIV FYSIK 8, 265 (1954)	600915
CA 49, 2188 (1955)	600915
 UHLER, U AKERLIND, L	 300476
(UNIV STOCKHOLM STOCKHOLM SWEDEN)	300476
ROTATIONAL ANALYSIS OF THE BLUE-GREEN AND ORANGE SYSTEMS OF YTTRIUM OXIDE	300476 300476
ARKIV FYSIK 19, 1 (1961)	300476
CA 56, 8174 (1962)	300476
BHTG NO 4, 18 (1962)	300476
 UHLER, U AKERLIND, L	 700844
(UNIV OF STOCKHOLM STOCKHOLM SWEDEN)	700844
ROTATION ANALYSIS OF THE BAND SYSTEMS OF YTTRIUM OXIDE	700844
NATURWISSENSCHAFTEN 46, 488 (1959)	700844
CA 54, 4144 (1960)	700844
 UKAJI, R MINAMI, F	 201623
(OSAKA METAL INDS LTD OSAKA JAPAN)	201623
REACTIVITY OF URANIUM OXIDE. VI. HYDRATION AND DEHYDRATION OF URANIUM TRIOXIDE	201623 201623
NIPPON GENSIRYOKU GAKKAISHI 3, 260 (1961)	201623
CA 57, 3061 (1962)	201623
 ULY, C LAM, D IANNIELLO, L PRÖBSTLE, R LEE, A	 202149
LÖH, B BURR, A	202149
(RENSSELAER POLYTECH INST TROY N Y)	202149
THE EFFECT OF RARE EARTH ELEMENTS ON THE ALLOTROPIC TRANSFORMATION OF ZIRCONIUM	202149 202149
US AT ENERGY COMM TID-12638, (1961)	202149
NUCL SCI ABSTR 15 (15) ABSTR NO 19878(1961)	202149
CA 59, 8433 (1963)	202149
 UMANSKI, M ZUBENKO, V ZOLINA, Z	 600859
THE QUESTION OF THE PRECISION MEASUREMENTS OF LATTICE PARAMETERS (DETERMINATION OF THE TUNGSTEN PARAMETER)	600859 600859
KRISTALLOGRAFIYA 5, NO 1, 51 (1960)	600859
PA 64, 11554 (1961)	600859
 UNSWORTH, W	 200876
ALLOYING OF THORIUM WITH MAGNESIUM	200876
MAGNESIUM ELEKTRON LTD BRIT 844, 546, (1960)	200876
CA 55, 5318 (1961)	200876

UNY, C		301036
(UNIV ALGER	ALGERIA)	301036
ELECTRICAL PROPERTIES AND SCINTILLATION EFFECT OF SOME		301036
METALLIC AND SEMICONDUCTOR THIN LAYERS		301036
ANN PHYS (PARIS) 6, 1275 (1961)		301036
CA 58, 5120 (1963)		301036
VAHLDIK, F LYNCH, C ROBINSON, L		600870
(WRIGHT AIR DEVELOPMENT DIV DAYTON	OHIO)	600870
THE INFLUENCE OF PRESSURE AND TEMPERATURE ON ZIRCONIUM OXIDE		600870
WADD-TR-60-705 (1960)		600870
NS 15, 13364 (1961)		600870
VAHLDIK, F MERSOL, S		301607
(METALS + CERAMICS LAB DAYTON	OHIO)	301607
PROPERTIES AND STRUCTURE OF BORIDES (SELECTED ARTICLES)		301607
AD 273601		301607
VAHLDIK, F W ROBINSON, L B LYNCH, C T		301606
(WRIGHT PATTERSON AIR FORCE DAYTON	OHIO)	301606
PHASE TRANSFORMATION OF ZIRCONIUM OXIDE		301606
INFLUENCE OF PRESSURE AND TEMPERATURE		301606
J CHEM ENG DATA 7, PT 1, 479 (1962)		301606
CA 58, 4281 (1963)		301606
VAINSHTEIN, E ZHURAKOVSKII, E STARYI, I		201163
X-RAY SPECTRAL STUDY OF TI BERYLLIDES		201163
DOKLADY AKAÐ NAUK SSSR 135, 642 (1960)		201163
CA 55, 21785 (1961)		201163
VAINSHTEIN, E BLOKHIN, S KRIPYAKEVICH, P		201585
X-RAY SPECTROSCOPIC STUDY OF TITANIUM BERYLLIDES HIGH IN		201585
BERYLLIUM		201585
DOKL AKAÐ NAUK SSSR 142, 85 (1962)		201585
CA 57, 532 (1962)		201585
VAN ARKEL, A		701056
(CARNEGIE INST OF TECH PITTSBURGH	PENN)	701056
CRYSTAL STRUCTURE AND PHYSICAL PROPERTIES		701056
PHYSICA 4, 286 (1924)		701056
AEC-TR-4800		701056
NSA 15, 29727 (1961)		701056
VAN ARKEL, A		201987
(RIJKSUNIV LEIDEN	NETHERLANDS)	201987
PREPARATION OF LESS COMMON METALS		201987
PURE APPL CHEM 5, 701 (1962)		201987
CA 58, 2223 (1963)		201987
VAN ARKEL, A FLOOD, E BRIGHT, N		600950
(INTL RES COUNCIL OTTAWA	CANADA)	600950
THE ELECTRICAL CONDUCTIVITY OF MOLTEN OXIDES		600950
CAN J CHEM 31, 1009 (1953)		600950
CA 48, 11140 (1954)		600950
VAN DEN BOSCH, J		400525
(ZEEMAN LAB AMSTERDAM	NETHERLANDS)	400525
NEW LEVELS IN THE URANIUM SPARK SPECTRUM (U2)		400525
PHYSICA 15, 503 (1949)		400525
CA 44, 2846 (1950)		400525

VAN DEN BOSCH, (ZEEMAN LAB REMARKS ON THE ANALYSIS OF THE FIRST URANIUM SPARK SPECTRUM PHYS REV 80, 100 (1950) CA 45, 443 (1951)	AMSTERDAM NETHERLANDS)	400554 400554 400554 400554 400554
VANDERSLICE, J. MASØN, F (UNIV OF MARYLAND RELATIONS AMONG POTENTIAL ENERGY CURVES OF DIATOMIC MOLECULES PROC INTERN MEETING MOL SPECTRY, 4TH, BØLØGNA, 1959 1, 323 (1962) CA 59, 8249 (1963)	CØLLEGE PARK MARYLAND)	202150 202150 202150 202150 202150 202150
VANDERSLICE, J. MASØN, E. LIPPINCOTT, E (UNIV OF MARYLAND INTERACTIONS BETWEEN GROUND STATE NITRØGEN ATØMS AND MOLECULES THE N-N, N-N2, AND N2-N2 INTERACTIONS J CHEM PHYS 30, 129 (1959) CA 53, 10939 (1959)	CØLLEGE PARK MARYLAND)	600601 600601 600601 600601 600601
VAN DIJKE BEATTY, S (WESTINGHOUSE RESEARCH LABS EAST PITTSBURGH THE WEAKER LINES IN THE PHOTOGRAPHIC REGION OF SOME LATE-TYPE STARS ASTROPHYS J 113, 93 (1951) CA 45, 4133 (1951)	PA)	400548 400548 400548 400548 400548
VAN KLEEF, A STRUCTURE AND ZEEMAN EFFECT IN THE SPECTRA OF THE ØSMIUM ATØM ØS I AND ØS II. IV-VI PROC K NED AKAD WETENSCH B (NETHERLANDS) 63, NØ 5, 549, 565, 581 (1961) PA 64, 2293 (1961)		600692 600692 600692 600692 600692
VAN KLEEF, A. KLINKENBERG, P (UNIV OF AMSTERDAM SPECTRAL STRUCTURE OF NEUTRAL AND IØNIZED ØSMIUM PHYSICA 27, 83 (1961) CA 55, 18290 (1961)	AMSTERDAM HØLLAND)	201113 201113 201113 201113 201113
VANNERBERG, N THE CRYSTAL STRUCTURE OF CALCIUM CARBIDE II AND IV ACTA CHEMICA SCANDINAVICA 16, NØ 5, 1212 (1962)		300596 300596 300596
VANNERBERG, N (CHALMERS TEK HØGSKØLA THE CRYSTAL STRUCTURE OF CALCIUM CARBIDE III ACTA CHEM SCAND 15, 769 (1961) CA 56, 4184 (1962)	GØTTENBØRG SWEDEN)	201300 201300 201300 201300 201300
VARSANYI, F. DIEKE, G (JØHNS HØPKINS UNIV INFRARED ABSØRPTION SPECTRUM OF NØ L3 J CHEM PHYS 33, 1616 (1960) CA 55, 16168 (1961)	BALTIMØRE MD)	201054 201054 201054 201054 201054
VARSHNI, Y. MAJUMDAR, K SPECTROSCOPIC CØNSTANTS OF MOLECULES V SIMILARITIES IN CØNSTANTS OF DIFFERENT GROUPS INDIAN J PHYS 30, 303 (1956) CA 51, 7307 (1957)		600895 600895 600895 600895 600895

VARSHNI, Y SHUKLA, R	700598
EVALUATION OF WEKE FROM THREE CONSTANT POTENTIAL ENERGY	700598
FUNCTIONS	700598
TRANS FARADAY SOC 57, 537 (1961)	700598
VASILEV, K STOICHKOVA, T	200995
SPEED OF REDUCTION OF MOO3 IN A FLUIDIZED BED	200995
GODISHNIK KHIM TEKHNOL INST 5, NO 1, 111 (1958)	200995
CA 55, 13009 (1961)	200995
VASILEV, V KHRYCHEVA, D D ARIYA, S M	301608
(STATE UNIV Leningrad RUSSIA)	301608
MAGNETIC SUSCEPTIBILITY OF LOWER TITANIUM OXIDES	301608
ZH NEORGAN KHIM 8, 788 (1963)	301608
CA 59, 3425E (1963)	301608
VASILEV, V ZOLSTAREV, E YATSIMIRSKII, K	700823
(CHEM TECHNOLOGICAL INST IVANOV RUSSIA)	700823
ENTROPY OF GASEOUS MONATOMIC IONS	700823
ZHUR FIZ KHIM 33, 328 (1959)	700823
CA 53, 21120 (1959)	700823
VASILEV, Y SOBOLLEVA, M	300767
(LENINGRAD STATE UNIV Leningrad RUSSIA)	300767
CALORIMETER FOR DETERMINING THE HEATS OF HIGH-	300767
TEMPERATURE PROCESSES	300767
ZHUR FIZ KHIM 36, 907 (1962)	300767
VASILEVA, I GERASIMOV, V SIMANOV, Y	200965
(M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	200965
THERMODYNAMIC INVESTIGATION OF THE REDUCTION OF TUNGSTEN TRI-	200965
OXIDE (ALPHA-WO3) BY HYDROGEN	200965
ZHUR FIZ KHIM 34, 1811 (1960)	200965
CA 55, 11167 (1961)	200965
VASILKOVA, I SHCHUKAREV, S ORANSKAYA, M TSINTSIUS, V	201222
SUBBOTINA, N	201222
DETERMINATION OF THE ENTHALPY OF FORMATION OF	201222
VANADIUM TRIBROMIDE	201222
VESTNIK Leningrad UNIV 16, NO 16, SER FIZI KHIM NO 3,	201222
125 (1961)	201222
CA 56, 1010 (1962)	201222
VASYUTINSKII, B KARTMAZOV, G FINKEL, V	201776
(PHYS TECH INST KHARKOV POLAND)	201776
DETERMINATION OF THE STRUCTURE OF TANTALUM UP TO 2700 DEGREES	201776
BY X-RAY DIFFRACTION	201776
UKR FIZ ZH 7, 661 (1962)	201776
CA 57, 8010 (1962)	201776
VASYUTINSKII, B KARTMAZOV, G FINKEL, V	201416
STRUCTURE OF CHROMIUM AT 700-1700 DEGREES	201416
FIZ METAL I METALLOVED AKAD NAUK SSSR 12, 771 (1961)	201416
CA 56, 9536 (1962)	201416
VATOLIN, N KISLING, R	301008
X-RAY DIFFRACTION STUDY OF PSEUDO TERNARY TUNGSTEN	301008
CARBIDE-TITANIUM CARBIDE-TANTALUM CARBIDE AND	301008
PSEUDO QUATERNARY TUNGSTEN CARBIDE-TITANIUM CARBIDE-	301008
TANTALUM-NI0BIUM CARBIDE	301008
IZV AKAD NAUK SSSR OTD TEKHN NAUK MET I TOPLIVO 1962, NO 3,	301008
102 (1962)	301008

VAUGHAN, D			601004
(BATTELLE MEM INST	COLUMBUS	OHIO	601004
X-RAY DIFFRACTION STUDY OF THE NITRIDES OF URANIUM			601004
J METALS 8, AIME TRANS 206, 78 (1956)			601004
CA 50, 4746 (1956)			601004
VAUGHAN, D STEWART, O SCHWARTZ, C			700990
(BATTELLE MEM INST	COLUMBUS	OHIO	700990
DETERMINATION OF INTERSTITIAL SOLID-SOLUBILITY LIMIT IN			700990
TANTALUM AND IDENTIFICATION OF THE PRECIPITATE PHASES			700990
BMI-1472 (1960)			700990
NSA 15, 4278 (1961)			700990
VDØVENKØ, V SUGLØBØVA, I			601155
DETERMINATION OF THE HEATS OF SOLUTION OF THE HYDRATES OF			601155
URANYL NITRATE IN DIETHYL AND DIBUTYL ETHERS			601155
ZHUR NEØRG KHIM 3, 1573 (1958)			601155
CA 53, 21120 (1959)			601155
VECHER, A GERASIMØV, Y			202151
EMF STUDIES OF THE THERMODYNAMIC PROPERTIES			202151
OF BINARY METALLIC SYSTEMS VIII			202151
ZHUR FIZ KHIM 37, 490 (1963)			202151
VEDAM, K			700961
(ATØMIC ENERGY EST	BØMBAY	INDIA)	700961
CRYSTAL SYMMETRY AND FERRØELECTRIC BEHAVIOR OF PYRØLUSITE			700961
(BETA-MNØ2)			700961
PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR			700961
PHYSICS, BØMBAY (1961)			700961
NP-10247			700961
NSA 15, 26692 (1961)			700961
VEINBACHS, A KØMAREK, K SILVER, M			601611
(NEW YØRK UNIV	NEW YØRK	NEW YØRK)	601611
THERMODYNAMIC PROPERTIES OF ZIRCØNIUM-OXYGEN, TITANIUM-OXYGEN,			601611
AND HAFNIUM-OXYGEN ALLOYS			601611
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,			601611
VIENNA, MAY (1962)			601611
NSA 16, 25384 (1962)			601611
VEITS, I GURVICH, L			600899
GROUND ELECTRONIC STATES IN ØXIDES OF GRØUP II ELEMENTS			600899
ØPTIKA I SPEKTRØSKØPIYA 2, 145 (1957)			600899
UCRL-TR-707			600899
CA 51, 7141 (1957)			600899
NSA 15, 32082 (1961)			600899
VEITS, I GURVICH, L			700964
DISSØCIATION ENERGIES OF ØXIDES OF MG, CA, SR AND BA			700964
ØPTIKA I SPEKTRØSKØPIYA 1, 22 (1956)			700964
UCRL-TR-706			700964
NSA 15, 29108 (1961)			700964
VEITS, I GURVICH, L			700965
(UNIV OF CALIFØRNI	BERKELEY	CALIF)	700965
ON THE DISSØCIATION ENERGIES OF MOLECULES OF THE ØXIDES OF THE			700965
ALKALINE EARTH ELEMENTS			700965
ZHUR FIZ KHIM 31, 2306 (1957)			700965
UCRL-TR-708			700965
NSA 15, 29109 (1961)			700965
VEKSHINA, N MARKØVSKII, L			201423

CHEMICAL PROPERTIES OF HEXABORIDES OF ALKALINE EARTH METALS ZHUR PRIKLAD KHIM 34, 2171 (1961) CA 56, 9680 (1962)	201423 201423 201423
VEKSHINA, N MARKOVSKII, L REACTIONS IN THE PRODUCTION OF ALKALINE EARTH METAL HEXABORIDES BY THE REDUCTION WITH CARBON ZH PRIKL KHIM 35, NO 1, 30 (1962) CA 56, 12536 (1962)	201487 201487 201487 201487 201487
VELISEK, J THE MEASUREMENT OF THERMODYNAMIC PROPERTIES OF METALS AND ALLOYS WITH A MASS-SPECTROMETER CHEM LISTY 57, 698-710 (1963) CA 59, 8187 (1963)	202152 202152 202152 202152 202152
VERESHCHAGIN, L SEMERCHAN, A POPOVA, S INVESTIGATION OF THE ELECTRICAL RESISTANCE OF CERIUM, LANTHANUM, AND NEODYMIUM AT PRESSURES UP TO 250,000 KG/SQ CM DOKL AKAD NAUK SSSR 138, 1059 (1961) CA 57, 191 (1962)	201570 201570 201570 201570 201570
VERHAEGEN, G MEASURE OF THERMODYNAMIC VALUES BY SPECTROMETRY STUDY OF SILVER AND COPPER AD 258475	300235 300235 300235 300235
VERHAEGEN, G DRÖWART, J (UNIV LIBRE BRUSSELS BELGIUM) MASS SPECTROMETRIC DETERMINATION OF THE HEAT OF SUBLIMATION OF BORON AND THE DISSOCIATION ENERGY OF B2 J CHEM PHYS 37, 1367 (1962) BHT (GASES) NO 6, (1962)	601658 601658 601658 601658 601658 601658
VERHAEGEN, G STAFFÖRD, F E VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURE AD 277796 APR (1962)	301609 301609 301609
VERHAEGEN, G STAFFÖRD, F VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES PART IX. CORRELATION OF DISSOCIATION ENERGIES OF GASEOUS MOLECULES AND OF HEATS OF VAPORIZATION OF SOLIDS. HOMONUCLEAR DIATOMIC MOLECULES AD 278830 (1962)	301010 301010 301010 301010 301010 301010
VERHAEGEN, G STAFFÖRD, F ACKERMAN, M (UNIV LIBRE BRUSSELS BELGIUM) VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURE PART III, MASS SPECTROMETRIC STUDIES OF THE MOLECULES BC2 IN THE VAPOR ABOVE THE SYSTEM BORON-CARBON WADD-TR-60-782 (PT III) NSA 16, 9144 (1962)	601574 601574 601574 601574 601574 601574 601574
VERHAEGEN, G STAFFÖRD, F ACKERMAN, M DRÖWART, J (UNIV LIBRE BRUSSELS BELGIUM) MASS SPECTROMETRIC INVESTIGATION OF GASEOUS SPECIES IN THE SYSTEM B-C NATURE 193, 1280 (1962) BHT (GASES) NO 6, (1962)	601660 601660 601660 601660 601660 601660
VERHAEGEN, G STAFFÖRD, F GOLDFINGER, P ACKERMAN, M CORRELATION OF DISSOCIATION ENERGIES OF GASEOUS MOLECULES AND OF HEATS OF VAPORIZATION OF SOLIDS	301050 301050 301050

HOMONUCLEAR DIATOMIC MOLECULES TRANS FAR SOC 58, 1926 (1962)	301050 301050
VERKHOGLYADOVA, T LVOV, S NEMCHEMKO, V SAMSONOV, G ELECTRIC AND GALVANOMAGNETIC PROPERTIES OF CHROMIUM NITRIDES FIZ METAL I METALLOVED, AKAD NAUK SSSR 12, 622 (1961) CA 56, 6755 (1962)	201355 201355 201355 201355
VERMA, R MULLIKEN, R A(1) SIGMA-3 PI(GAMMA) SPECTRUM OF SILICON MONOXIDE CAN J PHYS 39, 908 (1961) CT NO 12, (1961)	700637 700637 700637 700637
VERMA, R WARSOP, P (NATL RES COUNCIL OTTAWA CANADA) THE ABSORPTION SPECTRUM OF THE Si2 MOLECULE CAN J PHYS 41, 152 (1963) CA 58, 5151 (1963)	301032 301032 301032 301032 301032
VERNYL, E EGOROV, V ISOTOPIC SHIFT IN THE SPECTRUM OF TH232 TH229 OPTIKA I SPEKTROSKOPIYA 6, 262 (1959) CA 54, 10502 (1960)	601189 601189 601189 601189
VEROT, J FORESTIER, H PURIFICATION OF MOLYBDENUM BY FUSION UNDER ELECTRON BOMBARDMENT COMPT REND 253, 662 (1961) CA 56, 13907 (1962)	201528 201528 201528 201528 201528
VETEJSKA, K (USTAV PRO VYZKUM RUD PRAGUE CZECH) HAFNIUM CHEM LISTY 54, 1123 (1960) CA 55, 10169 (1961)	200950 200950 200950 200950 200950
VETEJSKA, K (USTAV PRO VYZKUM RUD PRAGUE CZECH) THORIUM CHEM LISTY 54, 114 (1960) CA 54, 10617 (1960)	601187 601187 601187 601187 601187
VETEJSKA, K (USTAV PRO VYZKUM RUD PRAGUE CZECH) URANIUM CHEM LISTY 54, 1 (1960) CA 54, 5309 (1960)	601199 601199 601199 601199 601199
VETRENKO, E MIKULINSKII, A FRESHBERG, I CALCULATION OF THE EQUILIBRIUM VAPOR PRESSURE AS MEASURED BY THE KNUDSEN EFFUSION METHOD ZHUR FIZ KHIM 36, 1585 (1962)	300603 300603 300603 300603
VICKERY, R THE CHEMISTRY OF YTTRIUM AND SCANDIUM PERGAMON PRESS 123, (1960) CA 54, 18054 (1960)	601173 601173 601173 601173
VICKERY, R SEDLACEK, R RUBEN, A (HORIZONS INC CLEVELAND OHIO) STUDIES ON RARE EARTH CARBIDES AFOSR-TN-58-38 (1958) NSA 13, 14217 (1959)	601532 601532 601532 601532 601532

VICKERY, R	MUIR, H		300232
(RESEARCH CHEMICALS INC	BURBANK	CALIFORNIA)	300232
REFRACTORY GADOLINIUM AND HAFNIUM COMPOUNDS			300232
FINAL REPT (1960) CONTRACT NO 77145 ARPA ORDER NO 81-59			300232
NP-9752 (1960)			300232
AD 258218			300232
NSA 15, 7772 (1961)			300232
VICKERY, R	SEDLACEK, R	RUBEN, A	700707
(HORIZONS INC	CLEVELAND	OHIO)	700707
RARE EARTH CARBIDES I			700707
J CHEM SOC, 498 (1959)			700707
CA 53, 11074 (1959)			700707
VICTOR, A			301386
HEAT CAPACITY OF DIAMOND AT HIGH TEMPS			301386
J CHEM PHYS 36, NO 7, 1903 (1962)			301386
BHT NO 2, 23 (1962)			301386
VICTOR, A C	DOUGLAS, T B		301372
THERMODYNAMIC PROPERTIES OF MAGNESIUM OXIDE AND BERYLLIUM			301372
OXIDE FORM 298 TO 1200 DEGREES K			301372
J RES NAT BUR STDS 67A, 325 (1963)			301372
VICTOR, A	DOUGLAS, T		202153
(NATL BUR OF STDS	WASHINGTON	D C)	202153
PHYSICAL PROPERTIES OF HIGH-TEMPERATURE MATERIALS			202153
US DEPT COM OFFICE TECH SERV AD258, 383, (4960)			202153
CA 58, 4749 (1963)			202153
VICTOR, A	DOUGLAS, T		201108
THERMODYNAMIC PROPERTIES OF THORIUM DIOXIDE FROM 298 TO 1200			201108
DEGREES K			201108
J RESEARCH NATL BUR STANDARDS 65A, 105 (1961)			201108
CA 55, 18276 (1961)			201108
VICTOR, A	DOUGLAS, T		700949
(NBS	WASHINGTON	DC)	700949
PHYSICAL PROPERTIES OF HIGH TEMPERATURE MATERIALS. VI.			700949
ENTHALPY AND HEAT CAPACITY OF MAGNESIUM OXIDE, ZIRCONIUM OXIDE			700949
AND ZIRCONIUM SILICATE FROM 0 DEGREES TO 900 DEGREES C			700949
WADC-TR-57-374 (1960)			700949
NSA 15, 22747 (1961)			700949
VIDALE, G			201616
(GE COMP	PHILADELPHIA	PA)	201616
MEASUREMENTS OF THE VAPOR PRESSURE OF ATOMIC SPECIES FROM			201616
SPECTROPHOTOMETRIC MEASUREMENTS OF THE ABSORPTION OF			201616
RESONANCE LINES. IV. STANDARD ENTHALPY OF FORMATION OF SILICON			201616
CARBIDE, AND OSCILLATOR STRENGTH OF THE SILICON 2516 A. LINE			201616
US DEPT COM OFFICE TECH SERV PB REPT 148,878, (1960)			201616
CA 57, 2932 (1962)			201616
VIDALE, G L			301610
(GENERAL ELEC	KING OF PRUSSIA	PENNA)	301610
MEASUREMENT OF THE VAPOR PRESSURE OF ATOMIC SPECIES FROM			301610
SPECTROPHOTOMETRIC MEASUREMENTS OF THE ABSORPTION OF			301610
RESONANCE LINES			301610
THE FREE ENERGY OF FORMATION TIC AND ZRC			301610
U S DEPT COM OFFICE TECH SERV A D 263 336 (1961)			301610
C A 58, 7435F (1963)			301610

VIDALE, G L		301611
(GEN ELEC CO		301611
SCHENECTADY	NEW YORK)	301611
THE VAPORIZATION OF GRAPHITE TIC, ZRC, AND HFC		301611
US DEPT COM OFFICE TECH SERV AD 259, 469 (1961)		301611
CA 58, 7387D (1963)		301611
VINTAIKIN, E		202155
FREE ENERGY OF FORMATION OF CHROMIUM CARBIDE		202155
FIZ METAL I METALLOVED 16 NO 1 144 (1963)		202155
VINTAIKIN, E TOMASH, Y		300452
VAPOR PRESSURE OF PURE COBALT		300452
ZHUR FIZ KHIM 35, 2121 (1961)		300452
BHTG NO 4, 1 (1962)		300452
VISHNEVSKII, I I GAVRISH, A M SUKHAREVSKII, B Y		301373
POSSIBLE MECHANISM OF STABILIZATION OF CUBIC ZR02		301373
SB NAUCHN TR UKR NAUCHN-ISSLED INST OGNEUPOROV (1962) 6, 74		301373
CA 59, 4605A (1963)		301373
VISHNEVSKII, I GAVRISH, A SUKHAREVSKII, B		202154
INVESTIGATION OF STABILIZATION AND DESTABILIZATION		202154
PROCESSES IN CUBIC ZIRCONIUM DIOXIDE		202154
RENT GENOGR, MINERALN SYRYA		202154
MINGEOL I OKHRANY NEDR SSSR VSES NAUCH-ISSLED INST MINERALN		202154
SYRYA AKAD NAUK SSSR 1962(2)5		202154
CA 58, 8184 (1963)		202154
VITTALACHAR, V KRISHNAMURTY, S		600897
(PRESIDENCY COLLEGE	MADRAS	600897
BAND SPECTRUM OF TUNGSTEN OXIDE	INDIA)	600897
CURRENT SCI INDIA 23, 357 (1954)		600897
CA 49, 6725 (1955)		600897
VLASOV, V KOZLOV, V		201591
LOW-TEMPERATURE CARBON-THERMAL REDUCTION OF U3O8		201591
ZH PRIKL KHIM 35, 660 (1962)		201591
CA 57, 1600 (1962)		201591
VLASOV, V LEBEDEV, A		201185
KINETICS OF DISSOCIATION OF URANIUM OXIDES		201185
ZHUR PRIKLAD KHIM 34, 1739 (1961)		201185
CA 56, 51 (1962)		201185
VLASOV, V SHALAGINOV, V		201027
REDUCTION OF URANIUM TRIOXIDE WITH CARBON MONOXIDE		201027
ZHUR PRIKLAD KHIM 34, 20 (1961)		201027
CA 55, 14023 (1961)		201027
VLASOV, V STREKALOVSKII, V		200985
INTERACTION OF HYDROGEN WITH UO3		200985
DOKLADY AKAD NAUK SSSR 134, 1384 (1960)		200985
CA 55, 12129 (1961)		200985
VLASOV, V G ZHURKOVSKII, V M		301612
EFFECT OF THE ADDITION OF SOME OXIDES ON THE KINETICS OF		301612
REDUCTION OF URANIUM TRIOXIDE BY DECOMPOSED AMMONIA		301612
ZH PRIKL KHIM 35, 1888 (1962)		301612
CA 58, 1941B (1963)		301612
VÖGEL, R		900105
CERIUM-IRON ALLOYS		900105
Z ANORG CHEM 99, 25 (1917)		900105

CA 11, 3229 (1917)	900105
VØGEL, R KEMPTER, C	601177
(LØS ALAMØS SCI LAB LØS ALAMØS N.M.)	601177
MATHEMATICAL TECHNIQUE FOR THE PRECISION DETERMINATION OF	601177
LATTICE CONSTANTS	601177
US ATOMIC ENERGY COMM LA2317 (1959)	601177
CA 54, 16087 (1960)	601177
VØITØVICH, R	201310
HIGH TEMPERATURE OXIDATION OF REFRACTORY ALLOYS IV. TANTALUM-	201310
TITANIUM AND TANTALUM-TUNGSTEN ALLOYS	201310
FIZ METAL I METALLØVED, AKAD NAUK S S S R 12, 376 (1961)	201310
CA 56, 4497 (1962)	201310
VØITØVICH, R	201287
HIGH-TEMPERATURE OXIDATION OF REFRACTORY ALLOYS V NIØBIUM-	201287
ZIRCONIUM AND NIØBIUM-TITANIUM ALLOYS	201287
FIZ METAL I METALLØVED AKAD NAUK S S S R 12, 576 (1961)	201287
CA 56, 3248 (1962)	201287
VØLPE, M MIHAILØVICH, S	201919
(ARGØNNE NATL LAB ARGØNNE ILL)	201919
KINETICS OF THE REDUCTION OF URANIUM OXIDES BY CARBON MONOXIDE	201919
AND BY HYDROGEN	201919
U S ATOMIC ENERGY COMM ANL 6475 (1962)	201919
CA 57, 15858 (1962)	201919
VØN BØLTØN, W	800117
THØRIUM	800117
Z ELEKTRØCHEM 14, 768 (1908)	800117
CA 3, 404 (1909)	800117
VØN WARTENBERG, H	900108
THØRIUM	900108
Z ELEKTRØCHEM 15, 866 (1909)	900108
CA 4, 873 (1910)	900108
VØRDAHL, M	500121
HEAT TREATMENT OF TITANIUM ALLOYS HAVING A DUPLEX	500121
ALPHA-BETA MICROSTRUCTURE	500121
US 2974076 (1961)	500121
CA 55, 14277 (1961)	500121
VØRØBEV, A NAKHØDNØVA, A	201600
ELECTRICAL CONDUCTIVITY OF OXIDES AND HALIDES OF GROUP II	201600
ELEMENTS	201600
IZV TØMSKØGØ PØLITEKHN INST 95, 325 (1958)	201600
CA 57, 1673 (1962)	201600
VØRØBEV, A PRIVALØVA, N SKURATØV, S	300135
CALØRIMETER FOR MEASURING THE ENTHALPY OF DECOMPOSITION OF	300135
SOLIDS	300135
ZHUR FIZ KHIM 34, 1142 (1960)	300135
BHT, 4 (1960)	300135
VØRØBEV, A SAVINTSEV, P	900210
THE IONIZATION POTENTIAL OF ATOMS AND THE MUTUAL SOLUBILITY	900210
OF METALS	900210
IZ VYSSHIKH UCHEB ZAVED FIZ NØ 3, 233 (1960)	900210
AEC-TR-5177	900210
VØRØNIN, N	301007

TRIAL BATCH OF PRODUCTION CARBORUNDUM REFRACTORIES WITH A SILICON NITRIDE BINDER OGNEUPORY 26, NO 4, 157 (1961) COTS NO 59, 107 (1962)	301007 301007 301007 301007
VORONKOV, M NATURE OF SI-O BONDS IN SILICATES LATVIJAS PSR ZINATNU AKAD VESTIS KIM SER 1961, NO 2, 283 (1961) CA 57, 6853 (1962)	301004 301004 301004 301004
VORONOV, N DANILIN, A INVESTIGATION OF EVAPORATION VELOCITY OF METAL-OXIDE SAMPLES HEATED BY ELECTRIC CURRENT SYMPOSIUM ON THERMODYNAMICS OF NUCLEAR MATERIALS, VIENNA (1962) AEC-TR-5416	301120 301120 301120 301120 301120
VORONOV, N VOITEKHOVA, E KOVALEV, I PHASE DIAGRAM OF THE SYSTEM UO ₂ -ZrO ₂ TR INST MET IM A A BAIKOVA (STRONIE SPLAVOV NEKOTORYKH SISTEM S URANOM I TORIEM) 467, (1961) CA 57, 15869 (1962)	201920 201920 201920 201920 201920
VOTINOV, M P DEMIDENKO, N I (M I KALININ POLYTECH INST Leningrad RUSSIA) TEMPERATURE VARIATION OF THE WIDTH OF THE ELECTRON PARAMAGNETIC RESONANCE (EPR) SPECTRUM IN TI-O SYSTEM FIZ TVERD TELA 4, 3277 (1962) CA 58, 4063F (1963)	301613 301613 301613 301613 301613
VOZZELLA, P MILLER, A DECRESCENTE, M (PRATT + WHITNEY AIRCRAFT MIDDLETOWN CONN) THERMAL DECOMPOSITION OF URANIUM MONOCARBIDE US AT ENERGY COMM PWAC-378, (1962)	202156 202156 202156 202156
VRATNY, F DILLING, M GUGLIOTTA, F RAJ, C (PURDUE UNIV LAFAYETTE INDIANA) INFRARED SPECTRA OF METALLIC OXIDES, PHOSPHATES AND CHROMATES J SCI IND RESEARCH (INDIA) 20B, 590 (1961) CA 56, 8181 (1962)	201385 201385 201385 201385 201385
VUKALOVICH, M ARTYM, R CALCULATION OF THERMODYNAMIC FUNCTIONS OF POLYATOMIC GASES TEPLOENERGETIKA 9, NO 6, 63 (1962) CA 57, 15891 (1962)	301005 301005 301005 301005
VUILLARD, G LUQUE, A (UNIV ALGER FRANCE) PREPARATION OF BORON CARBIDE IN THE SOLAR FURNACE COMPT REND 253, 1056 (1961) CA 56, 11166 (1962)	201467 201467 201467 201467 201467
VULF, B K ROMADIN, K P AVIATION PHYSICAL METALLURGY MOSCOW (1962) GOS IZD OBBORONNOI PROM (1962) CA 58, 5348B (1963)	301614 301614 301614 301614
WABER J T GSCHNEIDER K LARSON A C PRINCE M Y PREDICTION OF SOLID SOLUBILITY IN METALLIC ALLOY TRANS MET SOC AIME 227, 717 (1963)	301374 301374 301374
WACHTMAN, J SCUDERI, T CLEEK, G (NBS WASHINGTON DC)	601472 601472

LINEAR THERMAL EXPANSION OF AL ₂ O ₃ AND ThO ₂ FROM 100 DEGREES TO 1100 DEGREES K	601472
J AM CERAM SOC 45, 319 (1962)	601472
NSA 16, 24190 (1962)	601472
WADA, H KAWAI, Y SAITO, T	300289
THERMODYNAMICS OF THE IRON-CHROMIUM SYSTEM	300289
JAPAN INST OF METALS JOURNAL 24, 684 (1960)	300289
ASM REV 18, NO 2, 64 (1961)	300289
WADA, H KAWAI, Y SAITO, T	700627
ACTIVITY OF CHROMIUM IN LIQUID IRON-CHROMIUM SYSTEM	700627
SCI REPTS RESEARCH INSTS TOHOKU UNIV SER A 13, 96 (1961)	700627
CT NO 13, (1961)	700627
WADSLEY, A	201100
(CSIRO CHEM RESEARCH LAB MELBOURNE AUSTRALIA)	201100
MIXED OXIDES OF TITANIUM AND NIOBIUM	201100
ACTA CRYST 14, 660 (1961)	201100
CA 55, 18236 (1961)	201100
WADSLEY, A D	301615
(COMMONWEALTH SCI IND RES MELBOURNE AUSTRALIA)	301615
NONSTOICHIOMETRIC METAL OXIDES, ORDER AND DISORDER	301615
J AM CERAM SOC 45, 614 (1962)	301616
ADVAN CHEM 39, 23 (1963)	301615
CA 58, 13236D (1963)	301615
WADSLEY, A	201101
(CSIRO CHEM RESEARCH LAB MELBOURNE AUSTRALIA)	201101
THE CRYSTAL STRUCTURES OF THE DIMORPHIC FORMS OF Ti ₂ Nb ₁₀ O ₂₉	201101
ACTA CRYST 14, 664 (1961)	201101
CA 55, 18236 (1961)	201101
WAGNER, C	601025
(MIT CAMBRIDGE MASS)	601025
THERMODYNAMICS OF THE SYSTEM URANIUM-OXYGEN	601025
US ATOMIC ENERGY COMM WAPD-144 (1955)	601025
CA 50, 15193 (1956)	601025
WAHLBECK, P EDWARDS, R	301163
(ILLINOIS INST OF TECH CHICAGO ILL)	301163
CHEMICAL THERMODYNAMICS OF MATERIALS AT HIGH TEMPERATURES	301163
U S DEPT OF COMM OFFICE TECH SERV AD 259, 044 (1961)	301163
BHT NO 7, 4 (1963)	301163
WAHL, M	701053
(BAT MEM INST COLUMBUS OHIO)	701053
DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS	701053
ND-9606	701053
NSA 15, 5313 (1961)	701053
WAHL, M	700723
(BATTELLE MEM INST COLUMBUS OHIO)	700723
DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS	700723
NP-9861 (1960)	700723
NSA 15, 13350 (1961)	700723
WAIT, E	601268
(ATOMIC ENERGY RES EST HARWELL ENGLAND)	601268
A CUBIC FORM OF URANIUM TRIOXIDE	601268
J INORG AND NUCLEAR CHEM 1, 309 (1955)	601268
NSA 10, 501 (1956)	601268

WAKEFIELD, G			300724
VAPOR PRESSURE OF HOLMIUM METAL AND DECOMPOSITION			300724
PRESSURES OF HOLMIUM CARBIDES			300724
DISS ABS 22, 3433 (1962)			300724
WALDEN, G SMITH, D			201414
(UNIV ALABAMA	MONTGOMERY	ALA)	201414
HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF BISMUTH			201414
CHLORIDE AND CEROUS CHLORIDE			201414
US BUR MINES REPT INVEST NO 5859, (1961)			201414
CA 56, 9511 (1962)			201414
WALKER, B EWING, C MILLER, R			301098
SPECIFIC HEAT OF SOME HIGH TEMPERATURE MATERIALS			301098
J CHEM ENG DATA 7, 595 (1962)			301098
WALKER, R EFIMENKO, J LOFGREN, N			700579
RATE OF VAPORIZATION OF REFRACTORY SUBSTANCES			700579
PLANETARY AND SPACE SCIENCE 3, 24 (1961)			700579
WALLACE, D			700569
(AMES LAB	AMES	IOWA)	700569
SPECIFIC HEAT OF THORIUM AT HIGH TEMPERATURES			700569
PHYS REV 120, 84 (1960)			700569
CA 55, 3180 (1960)			700569
NSA 15, 681 (1961)			700569
WALLACE, W			201731
(UNIV PITTSBURG	PITTSBURG	PA)	201731
APPLICATION OF CHEMICAL THERMODYNAMICS AND RELATED PHENOMENA			201731
TO THE STUDY OF ALLOY FORMATION, THERMAL AND STRUCTURAL			201731
STUDIES OF TA2H, TA2D, MGN12, DYC05 SYSTEM			201731
STUDIES OF THE DY-H, TB-H, H0-H SYSTEM			201731
STUDIES OF THE KCL-KBR SYSTEM			201731
US AT ENERGY COMM TID-6038 (1960)			201731
CA 57, 5686 (1962)			201731
WALLACE, I BEARDSLEY, R			202157
THE SPECTRUM OF RHO CASSIOPEIAE			202157
ASTROPHYS J. SUPPL SER.S 381 (1961)			202157
CA 55 23035 (1961)			202157
WALLACE T C GUTIERREZ C P STONE P L			301375
(LOS ALAMOS SCI LAB	LOS ALAMOS	NEW MEXICO	301375
THE MO-ZR-C SYSTEM			301375
J PHYS CHEM 67, 796 (1963)			301375
WALSH, P DEVER, D WHITE, D			700642
(OHIO STATE UNIV	COLUMBUS	OHIO)	700642
RARE EARTHS III. A MASS SPECTROMETRIC INVESTIGATION OF THE			700642
ISOMOLECULAR OXYGEN-EXCHANGE REACTIONS OF LANTHANUM, CERIUM,			700642
PRASEODYMIUM, AND NEODYMIUM WITH THEIR MONOXIDES			700642
J PHYS CHEM 65, 1410 (1961)			700642
NSA 15, 29205 (1961)			700642
WALSH, P GOLDSTEIN, H WHITE, D			700566
(OHIO STATE UNIV	COLUMBUS	OHIO)	700566
VAPORIZATION OF RARE-EARTH OXIDES			700566
J AM CERAMIC SOC 43, 229 (1960)			700566
NSA 14, 13722 (1960)			700566

WALSH, P WHITE, D		700806
RARE EARTH OXIDES PT II VAPORIZATION OF LA2O3 AND Y2O3		700806
DISSOCIATION ENERGIES OF LAO, YO AND TAO		700806
AFOSR-TN-58-382 TECH NOTE NO 2, (1958)		700806
NUCL SCI ABSTR 12, 9737 (1598)		700806
WANG, C		301376
(COLORADO STATE UNIV	COLORADO	301376
STUDIES ON AL AND B PHOSPHIDES AND CUBIC BN		301376
DISSERTATION ABSTR 23, 3154 (1962-63)		301376
BHT NO 2 P (1963)		301376
WANG, K DREGER, V DADAPE, V MARGRAVE, J		300140
(UNIVERSITY OF WISCONSIN MADISON	WISC)	300140
SUBLIMATION OF CR2O3 AT HIGH TEMPERATURES		300140
J AM CERAM SOC 43, NO 10 509 (1960)		300140
BHT, 20 (1960)		300140
CA 55, 1116 (1961)		300140
NSA 15, 1391 (1961)		300140
WANG, C GRANT, N		202158
(MASS INST OF TECHNOLOGY CAMBRIDGE	MASS)	202158
TRANSFORMATION OF THE Ti3 PHASE		202158
TRANS AIME 206,184 (1956)		202158
WARD, J ALEXANDER, C LEMMON, A FILBERT, R		701055
(BATTELLE MEM INST COLUMBUS	OHIO)	701055
THERMODYNAMICS OF BORON LOSS IN UO2- STAINLESS STEEL		701055
DISPERSION FUEL ELEMENTS		701055
BMI-1531 (1961)		701055
NSA 15, 25576 (1961)		701055
WARF, J PALENIK, G		700849
(UNIV OF SOUTHERN CALIF LOS ANGELES	CALIF)	700849
CARBIDES AND NITRIDES OF THE RARE EARTH METALS PARTS I AND II		700849
FINAL REPORT - PROJ 683 CONTRACT DA-04-495-ORD-421		700849
NP 8585, (1960)		700849
NUCL SCI ABST 14, 14063 (1960)		700849
WARSHAW, I		201155
(PENN STATE UNIV	UNIV PARK PA)	201155
PHASE EQUILIBRIUM AND CRYSTAL CHEMICAL RELATIONS IN		201155
RARE EARTH SYSTEMS		201155
UNIV MICROFILMS (ANN ARBOR MICH) L C CARD NO MIC 61-2406		201155
DISSERTATION ABSTR 22, 279 (1961)		201155
CA 55, 21771 (1961)		201155
WARSHAW, I ROY, R		201358
(PENN STATE UNIV	UNIV PARK PA)	201358
POLYMORPHISM OF THE RARE EARTH SESQUIOXIDES		201358
J PHYS CHEM 65, 2048 (1961)		201358
CA 56, 6869 (1962)		201358
WARSHAW, I ROY, R		201808
(PENN STATE UNIV	UNIV PARK PA)	201808
A NEW FAMILY OF RARE EARTH COMPOUNDS		201808
INORG CHEM 1, 719 (1962)		201808
CA 57, 9438 (1962)		201808
WARTENBERG, H		700923
(UNIV GOTTINGEN	GOTTINGEN GERMANY)	700923
HEATS OF FORMATION OF LA2O3 AND LA(OH)3		700923
Z ANORG U ALLGEM CHEM 299, 227 (1959)		700923

CA 53, 16677 (1959)	700923
WASILEWSKI, R	201089
(DU PONT WILMINGTON DELAWARE)	201089
THE EXISTENCE OF LOWER TANTALUM OXIDES	201089
TRANS AIME 221, 647 (1961)	201089
CA 55, 17420 (1961)	201089
WASILEWSKI, R	201515
(E I DUPONT DE NEMOURS AND CO WILMINGTON DEL)	201515
ELECTRICAL RESISTIVITY OF TITANIUM	201515
TRANS AIME 224, 5 (1962)	201515
CA 56, 13652 (1962)	201515
WASILEWSKI, R	201516
(E I DUPONT DE NEMOURS AND CO WILMINGTON DEL)	201516
ELECTRICAL RESISTIVITY OF TITANIUM OXYGEN ALLOYS	201516
TRANS AIME 224, 8 (1962)	201516
REV MET LIT 19, (1962)	201516
CA 56, 13653 (1962)	201516
WASILEWSKI, R	201342
(E I DU PONT DE NEMOURS AND CO WILMINGTON DEL)	201342
THERMAL EXPANSION OF TITANIUM AND SOME TI-O ALLOYS	201342
TRANS AIME 221, 1231 (1961)	201342
CA 56, 5742 (1962)	201342
WATANABE, K MARMO, F	600567
PHOTOIONIZATION AND TOTAL ABSORPTION CROSS SECTION OF GASES	600567
II OXYGEN AND NITROGEN IN THE REGION 850-1500A	600567
J CHEM PHYS 25, 965 (1956)	600567
CA 51, 4137 (1957)	600567
WATANABE, K INN, E ZELIKOFF, M	600565
(AIR FORCE RESEARCH CENTER CAMBRIDGE MASS)	600565
ABSORPTION COEFFICIENTS OF GASES IN VACUUM ULTRAVIOLET	600565
J CHEM PHYS 20, 1969 (1952)	600565
CA 47, 47365 (1953)	600565
WATANABE, K INN, E ZELIKOFF, M	600566
(AIR FORCE RESEARCH CENTER CAMBRIDGE MASS)	600566
ABSORPTION COEFFICIENTS OF OXYGEN IN THE VACUUM ULTRAVIOLET	600566
J CHEM PHYS 21, 1026 (1953)	600566
CA 47, 9144 (1953)	600566
WATERSTRAT, R	201584
(UNIV OF ILLINOIS URBANA ILL)	201584
INVESTIGATION OF THE VANADIUM-MANGANESE ALLOY SYSTEM	201584
TRANS AIME 224, 240 (1962)	201584
CA 57, 523 (1962)	201584
WATERSTRAT, R DAS, B BECK, P	201702
(UNIV ILLINOIS URBANA ILL)	201702
PHASE RELATIONSHIPS IN THE TITANIUM-MANGANESE SYSTEM	201702
TRANS AIME 224, 512 (1962)	201702
CA 57, 4437 (1962)	201702
WATSON, J WILDER, D	201321
ROLES OF NIOBIUM PENTOXIDE VANADIUM PENTOXIDE AND TITANIUM-	201321
DIOXIDE IN THE GRAIN GROWTH AND SINTERING OF URANIUM DIOXIDE	201321
US ATOMIC ENERGY COMM IS-221 (1960)	201321
CA 56, 5469 (1962)	201321

WATSON, R			200816
(MIT	CAMBRIDGE	MASS)	200816
IRON SERIES HARTREE-FOCK CALCULATIONS II			200816
PHYS REV 119, 1934 (1960)			200816
CA 55, 2267 (1961)			200816
WATT, G			700590
RELATIVE STABILITIES OF OXIDATION STATES OF TRANSITIONAL			700590
METALS			700590
J ELECTROCHEM SOC 108, 423 (1961)			700590
WEBER, A MCGINNIS, E			600540
THE RAMAN SPECTRUM OF GASEOUS OXYGEN			600540
J MOL SPECTROSC 4, 195 (1960)			600540
WEBER, B			301616
(WRIGHT PATTERSON AIR FORCE DAYTON	OHIO)		301616
INCONSISTENCIES IN ZIRCONIA LITERATURE			301616
J AM CERAM SOC 45 614 (1962)			301616
CA 58, 7702 (1963)			301616
WEBER, B RIZZIO, H			202159
(WRIGHT PATTERSON AIR FORCE DAYTON	OHIO)		202159
COMPACTED SILICON-BORON POWDER MIXTURES OXIDIZED IN			202159
SINTERING TO REFRACTORY BODIES			202159
US 3096, 187 106 (1963) APPL (1959)			202159
CA 59, 7228 (1963)			202159
WEBSTER, A BRIGHT, N			300164
THE SYSTEM IRON-TITANIUM-OXYGEN AT 1200 DEGREES C AND OXYGEN			300164
PARTIAL PRESSURES BETWEEN 1 ATM AND 2×10^{-14} ATM			300164
J AM CERAM SOC 44 (3), 110 (1961)			300164
WEEKS, J			601282
(ARGONNE NATL LAB	LEMONT	ILL)	601282
THERMAL CONDUCTIVITY OF URANIUM AND SEVERAL URANIUM ALLOYS			601282
J METALS 7, 192 (1955)			601282
NSA 9, 1879 (1955)			601282
WEINER, R RAYNOR, G			200871
(UNIV EDGBASTON	BIRMINGHAM	ENGLAND)	200871
TRANSFORMATION IN METALLIC CERIUM			200871
J LESS COMMON METALS 1, 309 (1959)			200871
CA 55, 5282 (1961)			200871
WELLER, W KELLEY, K			700709
LOW TEMPERATURE HEAT CAPACITY AND ENTROPY AT 298.15 DEGREES K			700709
OF SCANDIUM			700709
US BUREAU OF MINES REP INVEST 5984 (1962)			700709
CA 57, 2930 (1962)			700709
WELLER, W W KING, E G			301617
(U S BUR OF MINES	BERKELEY	CALIF)	301617
LOW TEMPERATURE HEAT CAPACITIES AND ENTROPIES AT			301617
298.15 DEGREES K OF THE SESQUIOXIDES OF SCANDIUM AND CERIUM			301617
U S BUR MINES REPT INVEST NO 6245 (1963)			301617
CA 59, 5859H (1963)			301617
WELLS, P			301618
(UNIV QUEENSLAND	BRISBANE	AUSTRALIA)	301618
LINEAR FREE-ENERGY RELATIONS			301618
CHEM REV 63, 171 (1963)			301618
CA 58, 12016H (1963)			301618

WELTNER, W. WARN, J			300588
(UNION CARBIDE RESEARCH INST TARRYTOWN	NEW YORK)		300588
MATRIX ISOLATION OF HIGH-TEMPERATURE VAPORS BORIC			300588
OXIDE			300588
J CHEM PHYS 37, NO 2, 292 (1962)			300588
WELTY, J R. WICKS, C E			301619
ICE CALORIMETER FOR THE PRECISE MEASUREMENT OF HEAT CONTENT			301619
FROM 0 DEGREES TO 1500 DEGREES K			301619
BUR MINE REPT 6028 (1962)			301619
WENDLANDT, W. GEORGE, T			201275
(TEXAS TECHNOL COLL	LUBBOCK	TEXAS)	201275
THE THERMAL DECOMPOSITION OF INORGANIC COMPOUNDS IV			201275
RARE EARTH CARBONATES			201275
TEXAS J SCI 13, 316 (1961)			201275
CA 56, 3100 (1962)			201275
WENSEL, H. ROESER, W. BARBROW, L. CALDWELL, F			900133
DERIVATION OF PHOTOMETRIC STANDARDS FOR TUNGSTEN-FILAMENT			900133
LAMPS			900133
J RESEARCH NATL BUR STANDARDS 13, 161 (1934)			900133
WENSRICH, C			700972
(LAWRENCE RAD LAB	LIVERMORE	CALIF)	700972
MO, NB, TA, W, UO2, IN THE JOURNAL LITERATURES OF THE USSR			700972
UCRL-6110 (1960)			700972
NSA 15, 542 (1961)			700972
WENTORF, R			700935
(GE RESEARCH LAB	SCHENECTADY	NY)	700935
SYNTHESIS OF THE CUBIC FORM OF BORON NITRIDE			700935
J CHEM PHYS 34, 809 (1961)			700935
NSA 15, 12928 (1961)			700935
WENTORF JR, R H. KASPER, J S			301620
(GEN ELEC RES LAB	SCHENECTADY	N Y)	301620
TWO NEW FORMS OF SILICON			301620
SCIENCE 139, 338 (1963)			301620
CA 58, 7585D (1963)			301620
WERIER, R. RAYNOR, G			601359
(UNIV BIRMINGHAM	BIRMINGHAM	ENGLAND)	601359
A NOTE ON TRANSFORMATIONS IN METALLIC CERIUM			601359
J LESS COMMON METALS 1, 309 (1959)			601359
NSA 14, 6705 (1960)			601359
WESTBROOK, J. CARTER, R. DEVRIES, R			601449
(GE RESEARCH LAB	SCHENECTADY	NY)	601449
A SURVEY OF OXYGEN BINARY SYSTEMS I. RARE EARTH METAL-OXYGEN			601449
SYSTEMS			601449
61-RL-2634M (1961)			601449
NSA 16, 1646 (1962)			601449
WESTMAN, S			301621
(UNIV KANSAS	LAWRENCE	KANSAS)	301621
THE LOWER OXIDES OF VANADIUM			301621
ACTA CHEM SCAND 17, (3), 749 (1963)			301621
CA 59, 5880B (1963)			301621
WESTMAN, S			700545
(UNIV OF STOCKHOLM	STOCKHOLM	SWEDEN)	700545
NOTE ON A PHASE TRANSITION IN V02			700545

ACTA CHEM SCAND 15, 217 (1961)	700545
NSA 15, 18532 (1961)	700545
WESTMAN, S NORDMARK, C	201329
(UNIV STOCKHOLM STOCKHOLM SWEDEN)	201329
PHASE ANALYSIS STUDIES ON THE VANADIUM-OXYGEN SYSTEM WITHIN	201329
THE V0 0.25 - V0 1.5 REGION AT 800 DEGREES	201329
ACTA CHEM SCAND 14, 465 (1960)	201329
CA 56, 5614 (1962)	201329
WESTPHAL, R	601270
(WESTINGHOUSE ELEC CO PITTSBURGH PA)	601270
THERMAL CONDUCTIVITY OF REACTOR FUEL ELEMENT MATERIALS	601270
DECL DEC 6, 1955	601270
AECD-3864, NSA 10, 3616 (1956)	601270
WESTRUM, E GRONVOLD, F	601553
(MICH UNIV ANN ARBOR MICH)	601553
(OSLO UNIV OSLO SWEDEN)	601553
LOW TEMPERATURE HEAT CAPACITY AND THERMODYNAMIC FUNCTIONS	601553
OF U3O8	601553
AECU-3924 (1958)	601553
NSA 13, 3556 (1959)	601553
WESTRUM, E	600675
(MICHIGAN UNIV ANN ARBOR MICHIGAN)	600675
THERMAL AND ELECTRONIC PROPERTIES OF THE RARE EARTH OXIDES	600675
TID-11300 (1960)	600675
NS 15, 6390 (1961)	600675
WESTRUM, E	601689
(UNIV MICH ANN ARBOR MICH)	601689
THERMODYNAMIC PROPERTIES OF ACTINIDE CARBIDES WITH SPECIAL	601689
REFERENCE TO THE ENTROPIES OF URANIUM MONO- AND DI-CARBIDE	601689
TID 16987	601689
NSA 17, 151 (1963)	601689
WESTRUM, E	701021
(PURDUE UNIV LAFAYETTE IND)	701021
LOW TEMPERATURE CHEMICAL THERMODYNAMICS PROJECT	701021
TID-11188 (1960)	701021
NSA 15, 12795 (1961)	701021
WESTRUM, E BEALE, A	300350
HEAT CAPACITIES AND CHEMICAL THERMODYNAMICS OF CERIUM III	300350
FLUORIDE AND OF CERIUM IV OXIDE FROM 5 TO 300 DEG K	300350
J PHYS CHEM 65, 353 (1961)	300350
T I D 6515	300350
CA 56, 1008 (1962)	300350
NSA 14, 25455 (1960)	300350
WESTRUM, E F JR FEICK, G	301379
(U OF MICHIGAN ANN ARBOR MICH)	301379
(A D LITTLE CO CAMBRIDGE MASS)	301379
ZRC HEAT CAPACITY AND THERMODYNAMIC PROPERTIES FROM	301379
5 DEGREES TO 350 DEGREES K	301379
J CHFM ENG DATA 8, (2) 176 (1963)	301379
BHT NO 2 P 22 (1963)	301379
WESTRUM, E F JR FEICK, G	301378
(U OF MICHIGAN ANN ARBOR MICH)	301378
(A D LITTLE CO CAMBRIDGE MASS)	301378
ZRB2 HEAT CAPACITY AND THERMODYNAMIC PROPERTIES FROM	301378

5DEGREES TO 350 DEGREES K		301378
J CHFM ENG DATE 8, (2) 193 (1963)		301378
BHT NO 2 P 22 (1963)		301378
WESTRUM, E GRØNVOLD, F		300752
(MICHIGAN UNIV	ANN ARBOR	MICHIGAN)
TRIURANIUM HEPTAOXIDES HEAT CAPACITIES AND		300752
THERMODYNAMIC PROPERTIES OF ALPHA- AND BETA-U3O7 FROM		300752
5 TO 350 DEGREES K		300752
PHYS CHEM SOLIDS 23, 39 (1962)		300752
CA 57, 4112 (1962)		300752
WESTRUM, E GRØNVOLD, F		601133
(U. OF MICHIGAN	ANN ARBOR	MICH)
LOW-TEMPERATURE HEAT CAPACITY AND THERMODYNAMIC FUNCTIONS		601133
OF TRIURANIUM OXIDE		601133
J. AM CHEM SOC 81, 1777 (1959)		601133
CA 53, 14669 (1959)		601133
WESTRUM, E GRØNVOLD, F		601613
(MICHIGAN UNIV	ANN ARBOR	MICHIGAN)
CHEMICAL THERMODYNAMICS OF THE ACTINIDE ELEMENT CHALCOGENIDES		601613
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,		601613
VIENNA, MAY (1962)		601613
NSA 16, 25388 (1962)		601613
WESTRUM, E JUSTICE, B		601454
(UNIV OF MICH	ANN ARBOR	MICH)
LOW TEMPERATURE CHEMICAL THERMODYNAMICS OF THE		601454
LANTHANIDE SESQUIOXIDES		601454
TID-14101		601454
NSA 16, 96 (1962)		601454
WESTRUM, E JUSTICE, B		301012
THERMOPHYSICAL PROPERTIES OF THE LANTHANIDE OXIDES		301012
HEAT CAPACITIES, THERMODYNAMIC PROPERTIES, AND SOME		301012
ENERGY LEVELS OF DYSPROSIUM(III), HOLMIUM(III) AND		301012
ERBIUM(III) OXIDES		301012
J PHYS CHEM 67, NO 3, 659 (1963)		301012
WHATLEY, L		201679
(UNIV OF WISCONSIN	MADISON	WISCONSIN)
EXPERIMENTAL STUDIES ON THE NATURE OF SILICON-OXYGEN BOND		201679
UNIV MICROFILMS (ANN ARBOR, MICH) ORDER NO 62-1979, (1961)		201679
DISSERTATION ABSTR 22, 3388 (1962)		201679
CA 57, 4267 (1962)		201679
WHITE, D WALSH, P GOLDSTEIN, H DEVER, D		201217
A MASS SPECTROMETRIC DETERMINATION OF THE HEATS OF		201217
SUBLIMATION OR VAPORIZATION OF NEODYMIUM, PRASEODYMIUM,		201217
GADOLINIUM, TERBIUM, DYSPROSIUM, HOLMIUM, ERBIUM AND LUTETIUM		201217
J PHYS CHEM 65, 1404 (1961)		201217
CA 56, 1006 (1962)		201217
WHITE, D		601377
(OHIO STATE UNIV	COLUMBUS	OHIO)
STUDY OF SOLID VAPOR EQUILIBRIA IN THE		601377
RARE EARTH-RARE EARTH METAL SYSTEMS		601377
AFOSR-60-177 (1960)		601377
NSA 15, 8771 (1961)		601377
WHITE, D		300307
STUDY OF SOLID VAPOR EQUILIBRIA IN THE RARE EARTH-RARE EARTH		300307

METAL SYSTEMS	300307
AD 249224 DIV 25 FINAL REPT (1960)	300307
WHITE, D WALSH, P AMES, L GOLDSTEIN, H	601612
(OHIO STATE UNIVERSITY COLUMBUS OHIO)	601612
THERMODYNAMICS OF VAPORIZATION OF THE RARE EARTH OXIDES AT	601612
ELEVATED TEMPERATURES, DISSOCIATION ENERGIES OF THE GASEOUS	601612
MONOXIDES	601612
IAEA SYMPOSIUM ON THE THERMODYNAMICS OF NUCLEAR MATERIALS,	601612
VIENNA, MAY (1962)	601612
NSA 16, 25386 (1962)	601612
WHITE, D WALSH, P N GOLDSTEIN, H W DEVER, D F	301622
(OHIO STATE UNIV COLUMBUS OHIO)	301622
MASS SPECTROMETRIC DETERMINATION OF THE HEATS OF	301622
SUBLIMATION (OR VAPORIZATION) OF NEODYMIUM, PRASEODYMIUM,	301622
GADOLINIUM, TERBIUM, DYSPROSIUM, HOLMIUM, ERBIUM AND	301622
LUTETIUM	301622
US DEPT COM OFFICE TECH SERV PB REPT 157243 (1960)	301622
CA 58, 7439 (1963)	301622
WHITE, D WALSH, P MANN, D SOMMER, A	300685
(OHIO STATE UNIV COLUMBUS OHIO)	300685
THERMAL FUNCTIONS AND HEATS OF FORMATION OF SOME OF THE	300685
MAJOR VAPOR SPECIES IN THE BORON-OXYGEN-HYDROGEN	300685
SYSTEM AT ELEVATED TEMPERATURES	300685
US DEPT OF COMM OTS PB REPORT 147086 (1959)	300685
CA 56, 10998 (1962)	300685
WHITE, G	201739
(COMM SCI IND RES ORGAN SYDNEY AUSTRALIA)	201739
THERMAL EXPANSION AT LOW TEMPERATURES. II. ELECTRONIC	201739
COMPONENTS IN METALS	201739
PHIL MAG 6, 815 (1961)	201739
CA 57, 6644 (1962)	201739
WHITE, G WOODS, S	601050
(NATL RESEARCH COUNCIL OTTAWA CANADA)	601050
THERMAL AND ELECTRICAL CONDUCTIVITY OF RHODIUM, IRIIDIUM AND	601050
PLATINUM	601050
CAN J PHYS 35, 248 (1957)	601050
CA 51, 7781 (1957)	601050
WHITE, G WOODS, S	601162
(NATIONAL RES COUN OTTAWA CANADA)	601162
ELECTRICAL AND THERMAL RESISTIVITY OF THE TRANSITION ELEMENTS	601162
AT LOW TEMPERATURES	601162
PHIL TRANS ROY SOC 251, 273 (1959)	601162
CA 54, 23559 (1960)	601162
WHITE, J	300318
THERMODYNAMIC ANALYSIS OF SOLUBILITY IN LIQUID METAL SYSTEMS	300318
NRL REPORT 5555 (1960)	300318
US GOV PUB 8091 (1961)	300318
PB 161968	300318
WHITE, P	300732
(INTERN BUSINESS MACHINES NEW YORK NEW YORK)	300732
GAS PHASE OXIDATION OF SILICON MONOXIDE DURING FORMATION	300732
OF EVAPORATED FILMS	300732
VACUUM 12, 15 (1962)	300732
CA 57, 2910 (1962)	300732

WHITMORE, D H			301254
(NORTHWESTERN UNIV	EVANSTON	ILL)	301254
THERMOELECTRIC POWER IN NONSTOICHIOMETRIC ALPHA-NB2O5			301254
C CHEM PHYS 39 (1), 179 (1963)			301254
CA 59, 2247F (1963)			301254
WHITNEY, E			301017
EFFECT OF PRESSURE ON MONOCLINIC-TETRAGONAL TRANSITION OF			301017
ZIRCONIA. THERMODYNAMICS			301017
J AM CERAM SOC 45, NO 12, 612 (1962)			301017
WHITNEY, E			202160
(CARBORUNDUM CO	NIAGRA FALLS	N Y)	202160
POLYMORPHISM IN SiC			202160
NATURE 199 (4890) 278 (1963)			202160
CA 59, 8204 (1963)			202160
WICHERS, E			300359
NEW SCALE OF NUCLIDIC MASSES AND ATOMIC WEIGHTS			300359
NATURE 194, 621 (1962)			300359
WICKERSHEIM, K LEFEVER, R			201301
(HUGHES RES LABS	MALIBU	CALIF)	201301
INFRARED TRANSMITTANCE OF CRYSTALLINE YTTRIUM OXIDE AND RELATED			201301
COMPOUNDS			201301
J OPT SOC AM 51, 1147 (1961)			201301
CA 56, 4262 (1962)			201301
WIEDERKEHR, R			301056
(DOW CHEMICAL CO	MIDLAND	MICH)	301056
MATRIX REPRESENTATION OF THERMODYNAMIC PROPERTIES			301056
OF MULTICOMPONENT SYSTEMS			301056
J CHEM PHYS 37, 1192 (1962)			301056
WILCOX, D			301011
(LAWRENCE RAD LAB	BERKELEY	CAL)	301011
METHOD FOR ESTIMATING THE HEAT OF FORMATION AND FREE ENERGY OF			301011
FORMATION OF INORGANIC COMPOUNDS			301011
USAEC-UCRL 10397 (1962)			301011
CA 58, 979 (1963).			301011
WILHELM, E DAANE, A CARTER, J SNOW, A			601264
(IOWA STATE COLL	AMES	IOWA)	601264
THE URANIUM-CARBON SYSTEM			601264
NSA 10, 5283 (1956)			601264
WILHELM, H CHIOTTI, P			400521
(IOWA STATE COLLEGE	AMES	IOWA)	400521
TH-C SYSTEM			400521
TRANS AM SOC MET 42, 1295 (1950)			400521
CA 44, 5777 (1950)			400521
WILHELM, H CHIOTTI, P SNOW, A DAANE, A			400536
(IOWA STATE COLLEGE	AMES	IOWA)	400536
THE CARBIDES OF URANIUM AND THORIUM			400536
J CHEM SOC 1949, 2, 318 (1949)			400536
CA 44, 8808 (1950)			400536
WILHELM, H DAANE, A			601009
URANIUM CARBIDES			601009
BRIT 740,001, (1955)			601009
CA 50, 6970 (1956)			601009

WILKINSON, M CHILD, H MCHARGUE, C KOHLER, W WOLLAN, E (OAK RIDGE NATL LAB OAK RIDGE TENN) NEUTRON DIFFRACTION INVESTIGATIONS OF METALLIC CERIUM AT LOW TEMPERATURES PHYS REV 122, 1409 (1961) NSA 15, 19918 (1961)	601412 601412 601412 601412 601412 601412
WILKINSON, P (UNIVERSITY OF CHICAGO CHICAGO ILL) HIGH RESOLUTION ABSORPTION SPECTRA OF NITROGEN IN THE VACUUM ULTRAVIOLET ASTROPHYS J 126, 1 (1957) CA 51, 17437 (1957)	600602 600602 600602 600602 600602 600602
WILKINSON, P (UNIVERSITY OF CHICAGO CHICAGO ILL) FORBIDDEN BAND SYSTEMS IN NITROGEN III J CHEM PHYS 32, 1061 (1960)	600604 600604 600604 600604
WILKINSON, P (UNIVERSITY OF CHICAGO CHICAGO ILL) FORBIDDEN BAND SYSTEMS IN NITROGEN I THE VEGARD-KAPLAN SYSTEM IN ABSORPTION J CHEM PHYS 30, 773 (1959) CA 53, 15754 (1959)	600605 600605 600605 600605 600605 600605
WILKINSON, P MULLIKEN, R (UNIVERSITY OF CHICAGO CHICAGO ILL) DISSOCIATION PROCESSES IN OXYGEN ABOVE 1750A ASTROPHYSICS J 125, 594 (1957) CA 51, 12648 (1957)	600543 600543 600543 600543 600543
WILKINSON, P MULLIKEN, R (UNIVERSITY OF CHICAGO CHICAGO ILL) ELECTRIC QUADRUPLE ELECTRONIC BAND SYSTEM IN MOLECULAR NITROGEN ASTROPHYS J 126, 10 (1957) CA 51, 17437 (1957)	600603 600603 600603 600603 600603 600603
WILLARDSON, R MOODY, J GOERING, H. (BATTELLE MEM INST COLUMBUS OHIO) ELECTRICAL PROPERTIES OF URANIUM OXIDES J INORG AND NUCLEAR CHEM 6, 19 (1958) CA 52, 8745 (1958)	601104 601104 601104 601104 601104
WILLIAMS, D (BATTELLE MEM INST COLUMBUS OHIO) PROPERTIES OF BORON US DEPT COM OFFICE OF TECH SERV PB REPT 262292, (1960) CA 56, 4343 (1962)	201304 201304 201304 201304 201304
WILLIAMS, D (BATTELLE MEM INST COLUMBUS OHIO) THERMAL EXPANSION OF BETA-TITANIUM TRANS AIME 221, 411 (1961) CA 55, 13238 (1961)	600782 600782 600782 600782 600782
WILLIAMS, D JACKSON, R LARSEN, W THE TANTALUM-ZIRCONIUM ALLOY SYSTEM TRANS MET SOC AIME 224, 751 (1962)	301016 301016 301016
WILLIAMS, E BORON DIFFUSION IN SILICON	300505 300505

J ELECTROCHEM SOC 108, NO 8, 795 (1961) BHT NO 3, 30 (1961)		300505 300505
WILLIAMS, G BAKER, E ZIRCONIUM AND HAFNIUM A BIBLIOGRAPHY NYO-1008, 236 (1950)		600904 600904 600904
WILLIAMS, J SAMBELL, R (ATOMIC ENERGY RES ESTAB HARWELL THE URANIUM MONOCARBIDE-URANIUM MONONITRIDE SYSTEM J LESS COMMON METALS 1, 217 (1959) CA 55, 5285 (1961)	ENGLAND)	200872 200872 200872 200872 200872 200872
WILLIAMS, J SAMBELL, R WILKENSØN, D (U K ATOMIC ENERGY AUTHORITY HARWELL THE VARIATION OF UNIT-CELL EDGE OF URANIUM MONOCARBIDE IN ARC MELTED URANIUM-CARBON ALLOYS J LESS COMMON METALS 2, 352 (1960) NSA 15, 4319 (1961)	ENGLAND)	601388 601388 601388 601388 601388 601388 601388
WILLIAMS, M HIGH TEMPERATURE HEAT CAPACITY EQUATIONS AND THERMODYNAMIC PROPERTIES OF COMBUSTION GASES AD 255963 (15 MAY 1961) GR 36, NO 1, 117 (1961)		700654 700654 700654 700654 700654
WILLIAMS, W THE HEAT OF FORMATION OF TiB ₂ EXPERIMENTAL AND ANALYTICAL RESOLUTION OF LITERATURE CONFLICT J PHYS CHEM 65, NO 12, 2213 (1961) BHT NO 2, 14 (1962)		300523 300523 300523 300523 300523
WILLIS, B (AT ENERGY RES ESTAB HARTWELL POSITIONS OF THE OXYGEN ATOMS IN UO ₂ NATURE 197, 755 (1963) CA 58, 10810E (1963)	ENGLAND)	301623 301623 301623 301623 301623
WILSON, A RUNDLE, R THE STRUCTURES OF URANIUM METAL ACTA CRYST 2, 126 (1949) NSA 4, 145 (1950)		601360 601360 601360 601360
WILSON, B PRODUCTION OF PURE REACTIVE METALS FROM THEIR CARBIDES UNION CARBIDE CORP US PAT 2,965,475 (1960) CA 55, 6349 (1961)		200895 200895 200895 200895 200895
WILSON, C THEKAKARA, M (GEORGETOWN UNIV WASHINGTON DC) ULTRAVIOLET SPECTRUM OF Ti J OPT SOC AM 51, 289 (1961) CA 55, 13043 (1961)	DC)	201001 201001 201001 201001 201001
WILSON, F EMPIRICAL BOND ENERGIES REPT NO AFFTC-TR61-27 (1961) AD-257383		300309 300309 300309 300309
WILSON, J MCKINSEY, C		201094

UNION CARBIDE METALS CO	NIAGARA FALLS	NEW YORK)	201094
TUNGSTEN-NIÖBIUM-TANTALUM ALLOYS. THEIR HIGH-TEMPERATURE			201094
PROPERTIES			201094
J METALS 13, 494 (1961)			201094
CA 55, 17444 (1961)			201094
WILSON, W			601183
(GEN ELEC CO.	CINCINNATI	OHIO)	601183
U308 SINGLE CRYSTALS			601183
US ATOMIC ENERGY COMM APEX-187, (1960)			601183
CA 54, 12713 (1960)			601183
WILSON, W			601193
(BATTELLE MEM INST	COLUMBUS	OHIO)	601193
HIGH-TEMPERATURE X-RAY DIFFRACTION INVESTIGATION OF THE			601193
URANIUM-CARBON SYSTEM			601193
J AM CERAM SOC 43, 77 (1960)			601193
CA 54, 7317 (1960)			601193
WILSON, W			601448
(BATTELLE MEMORIAL INST	COLUMBUS	OHIO)	601448
HIGH PRESSURE,-HIGH TEMPERATURE INVESTIGATION OF THE			601448
URANIUM-OXYGEN SYSTEM			601448
J INORG NUCLEAR CHEM 19, 212 (1961)			601448
NSA 16, 1780 (1962)			601448
WILSON, W AUSTIN, A SCHWARTZ, C			601071
(BATTELLE MEMORIAL INST	COLUMBUS	OHIO)	601071
SOLID SOLUBILITY OF URANIUM IN THORIUM AND THE ALLOTROPIC			601071
TRANSFORMATION OF THORIUM-URANIUM ALLOYS			601071
US ATOMIC ENERGY COMM BMI-1111 (1956)			601071
CA 51, 1007 (1957)			601071
WILSON, A RUNDLE, R			601657
THE STRUCTURES OF URANIUM METAL			601657
ACTA CRYST 2, 126 (1949)			601657
WINTERBOTTOM, W HIRTH, J			300560
(OHIO STATE UNIVERSITY	COLUMBUS	OHIO)	300560
DIFFUSIONAL CONTRIBUTION TO THE TOTAL FLOW FROM			300560
A KNUDSEN CELL			300560
J CHEM PHYS 37, NO 4, 784 (1962)			300560
WISE, S			300741
(ARGONNE NATL LAB	ARGONNE	ILL)	300741
HEATS OF FORMATION OF SOME INORGANIC COMPOUNDS BY			300741
FLUORINE BOMB CALORIMETRY			300741
US ATOMIC ENERGY COMM ANL-6472 (1962)			300741
CA 56, 10998 (1962)			300741
WISE S S MARGRAVE J L			301381
FEDER H M HUBBARD W N			301381
(UNIV OF WISCONSIN	MADISON	WISCONSIN)	301381
(ARGONNE NAT LAB	ARGONNE	ILL)	301381
FLUORINE BOMB CALORIMETRY. V. THE HEATS OF FORMATION			301381
OF SILICON TETRAFLUORIDE AND SILICA			301381
J PHYS CHEM. 67, (4) 815 (1963)			301381
BHT NO 2 P 23 (1963)			301381
WISE, S MARGRAVE, J FEDER, H HUBBARD, W			300396
THE HEAT OF FORMATION OF SILICA AND SiF4			300396
J PHYS CHEM 66, 381 (1962)			300396

WISNYI, L PIJANOWSKI, S		601056
(GEN ELEC COMPANY	SCHENECTADY NY)	601056
DETERMINATION OF THE MELTING POINTS OF UO ₂ AND OTHER		601056
REACTOR REFRACTORIES		601056
US ATOMIC ENERGY COMM TID-7530 (1957)		601056
TID-7530 (1957)		601056
CA 51, 11684 (1957)		601056
WISNYI, L PIJANOWSKI, S		601081
(GENERAL ELECTRIC CO	SCHENECTADY NEW YORK)	601081
THERMAL STABILITY OF URANIUM DIOXIDE		601081
US ATOMIC ENERGY COMM KAPL-1702 (1957)		601081
CA 52, 16015 (1958)		601081
WITTIG, F E		301624
(UNIV MUNICH	MUNICH GERMANY)	301624
CALORIMETRIC DETERMINATIONS AT HIGHER TEMPERATURES		301624
PURE APPL CHEM 2, 183 (1961)		301624
CA 56, 69 (1962)		301624
WÖHLER, L JOCHUM, N		900124
THERMAL CHEMICAL MEASUREMENTS OF THE OXIDES OF COPPER, RHODIUM		900124
PALLADIUM AND INDIUM		900124
Z PHYSIK CHEM A167, 169 (1933)		900124
CA 28, 2604 (1934)		900124
WÖHLER, L MULLER, W		900140
THE CHLORIDES AND OXIDES OF RHODIUM		900140
Z ANORG CHEM 149, 125 (1925)		900140
CA 20, 344 (1926)		900140
WÖHLER, L WITZMANN, W		900125
THE FORMATION OF SOLID SOLUTIONS DURING THE DISSOCIATION OF		900125
IRIDIUM OXIDE		900125
Z ELEKTROCHEM 14, 97 (1908)		900125
CA 2, 1523 (1908)		900125
WOLF, L SCHWAB, H		201408
(KARL-MARX UNIVERSITY	LIPZIG GERMANY)	201408
SEPARATION OF RARE EARTHS. VIII. X-RAY INVESTIGATION OF THE		201408
LA-YR OXIDE SYSTEM		201408
J PRAKT CHEM 13, 337 (1961)		201408
CA 56, 9481 (1962)		201408
WOLFSBERG, M		600546
(BROOKHAVEN NATL LAB	UPTON NEW YORK)	600546
A NITROGEN MOLECULE CALCULATION		600546
J CHEM PHYS 21, 2166 (1953)		600546
CA 48, 4270 (1954)		600546
WOLLAN, E WILKINSON, M CABLE, J		301504
(OAK RIDGE NATL LAB	OAK RIDGE TENN)	301504
MAGNETIC STRUCTURE PROPERTIES OF RARE EARTH METALS		301504
RARE EARTH RES. SEMINAR, LAKE ARROWHEAD, CALIF 1960, 149 (1961)		301504
CA 58, 7487 (1963)		301504
WOLTEN, G		202161
DIFFUSIONLESS PHASE TRANSFORMATIONS IN ZIRCONIA AND HAFNIA		202161
J AM CERAMICS SOC 46, 418 (1963)		202161
WOOD, R		201956
(IMP METAL IND LTD	BIRMINGHAM ENGLAND)	201956
THE LATTICE CONSTANT OF HIGH PURITY ALPHA TITANIUM		201956

PROC PHY SOC 80, 783 (1962)	201956
CA 58, 91 (1963)	201956
WOODWARD, L CREIGHTON, J TAYLOR, K	200760
(OXFORD UNIVERSITY OXFORD ENGLAND)	200760
RAMAN SPECTRUM OF THE OSMIATE ION	200760
TRANS FARADAY SOC 56, 1267 (1960)	200760
CA 55, 5124 (1961)	200760
WOLF, A	201232
(ASSOC ELEC IND ALDERMASTON ENGLAND)	201232
AN OUTLINE OF RHENIUM CHEMISTRY	201232
QUART REV (LONDON) 15, 372 (1961)	201232
CA 56, 1247 (1962)	201232
WORLEY, R	600606
A THIRD RYDBERG SERIES OF NITROGEN	600606
PHYS REV 89, 863 (1953)	600606
CA 47, 7889 (1953)	600606
WÖRNER, H	200991
(UNIV MELBOURNE MELBOURNE AUSTRALIA)	200991
ALLOTROPIC TRANSFORMATIONS IN DILUTE ALLOYS BASED ON IRON,	200991
TITANIUM, AND ZIRCONIUM	200991
J AUSTRALIAN INST METALS 5, 154 (1960)	200991
CA 55, 12972 (1961)	200991
WOJCIK, P KIRKWOOD, J	700641
(YALE UNIV NEW HAVEN CONN)	700641
CONTRIBUTION OF LATTICE VIBRATIONS TO THE ORDER-DISORDER	700641
TRANSFORMATION IN ALLOYS	700641
J CHEM PHYS 33, 1299 (1960)	700641
WRAY, K CONNOLLY, T	600620
(AVCO-EVERETT RES LAB EVERETT MASS)	600620
THERMAL CONDUCTIVITY OF CLEAR FUSED SILICA AT HIGH	600620
TEMPERATURES	600620
AD 211724 (1959)	600620
NS 14, 21999 (1960)	600620
WRIGHT, K	100212
LINE INTENSITIES IN THE SPECTRA OF FOUR SOLAR-TYPE STARS	100212
PUB DOMINION ASTROPHYS OBS, VICTORIA, BC 8, 1 (1948)	100212
CA 45, 3710 (1951)	100212
WUENSCH, B VASILOS, T	201835
(AVCO WILMINGTON MASS)	201835
DIFFUSION OF TRANSITION METAL IONS IN SINGLE-CRYSTAL MgO	201835
J CHEM PHYS 36, 2917 (1962)	201835
CA 57, 11873 (1962)	201835
WUENSCH, B VASILOS, T	301018
(AVCO WILMINGTON MASS)	301018
DIFFUSION IN REFRACTORY OXIDES	301018
PROC INTERN SYMP REACTIVITY SOLID 4TH AMSTERDAM 1960, 57 (1961)	301018
CA 58, 1218 (1963)	301018
WYDER W C HOCH M	301383
(UNIV OF CINCINNATI CINCINNATI OH)	301383
THE POLYMORPHIC FORMS OF CHROMIUM	301383
CA 59, 4866G (1963)	301383
WYDER, W HOCH, M	300548

(UNIV OF CINCINNATI	CINCINNATI	OHIO)	300548
THE SYSTEM Nb-Ti-Zr-O AT 1500 DEG C			300548
TRANS AIME 224, 373 (1962)			300548
BHT NO 2, 47 (1962)			300548
CA 57, 523 (1962)			300548
WYLIE, A			400550
THE RARE EARTHS OR LANTHANONS			400550
ROYAL AUSTRALIAN CHEM INST J PROC 17, 377 (1950)			400550
CA 45, 3210 (1951)			400550
NSA 5, 1237 (1950)			400550
YAHIA, J FREDERIKSE, H			300490
ELECTRICAL CONDUCTION IN P-TYPE TITANIUM SESQUIOXIDE			300490
PHYS REV 123, NO 4, 1257 (1961)			300490
BHT NO 3, 17 (1961)			300490
YAKOVLEVA, M KRASILOVA, Z			300351
HEAT CAPACITY OF A FEW VANADIUM OXIDES			300351
VESTNIK Leningrad UNIV 16, NO 16 SER FIZ I KHIM NO 3 136 (1961)			300351
CA 56, 1008 (1962)			300351
YAMAMOTO, A LUNDIN, C NACHMAN, J			300230
DENVER RES INST DENVER COLORADO)			300230
A FUNDAMENTAL INVESTIGATION OF THE ALLLOYING BEHAVIOR OF THE			300230
RARE EARTHS AND RELATED METALS			300230
SEMI ANNUAL PROG REPT NO 3 (1960-1961) AD 256786			300230
YAMASHITA, J			301625
(UNIV TOKYO TOKYO JAPAN)			301625
ELECTRONIC STRUCTURE OF TiO AND NiO			301625
J PHYS SOC (JAPAN) 18 (7), 1010 (1963)			301625
CA 54, 23507D			301625
CA 59, 3389G (1963)			301625
YARYM-AGAIEV, N KOGAN, E SOLDATOVA, E			300700
CALCULATION OF THE SATURATED VAPOR PRESSURE IN BINARY			300700
SYSTEMS IN WHICH CHEMICAL REACTION OCCURS IN THE			300700
VAPOR PHASE			300700
ZHUR FIZ KHIM 36, NO 6, 1173 (1962)			300700
YASUDA, S			300581
THE TRANSITION OF SILICON CARBIDE FROM ITS BETA TO ALPHA FORM			300581
DENKI KAGAKU 30, NO 8, 587 (1962)			300581
CT NO 17, 77 (1962)			300581
YATSIMIRSKII, K			300180
LATTICE ENERGY OF METAL SALTS AND OXIDES			300180
ZHUR NEORG KHIM 6, NO 3, 518 (1961)			300180
RUSS A, 635 (1961)			300180
YATSIMIRSKII, K			400583
ENERGETICS OF LANTHANIDE IONS			400583
IZVEST AKAD NAUK SSSR OTDEL KHIM NAUK 648 (1949)			400583
CA 44, 3345 (1950)			400583
YATSIMIRSKII, K			700751
CALCULATION OF THE IONIZATION POTENTIALS OF SOME LANTHANIDES			700751
WITH THE AID OF THE KAPUSTINSKII EQUATION			700751
IZVEST AKAD NAUK SSSR, OTDEL KHIM NAUK, 554 (1948)			700751

CA 43, 1254 (1949)	700751
YAVORSKY, P	201763
(ZIRCONIUM CORP AMERICA SOLON OHIO)	201763
PROPERTIES AND HIGH TEMPERATURE APPLICATIONS OF ZIRCONIUM	201763
OXIDE	201763
CERAM AGE 78, NO 6, 64968 (1962)	201763
CA 57, 6893 (1962)	201763
YELYNTIN, V BERNSTEYN, M PAVLOV, Y	300283
THE STUDY OF THE STRUCTURE OF TITANIUM-NIUBIUM-CARBON ALLOYS	300283
WITH AN ULTRAVIOLET MICROSCOPE	300283
DOKL AKAD NAUK SSSR 104, 546 (1955)	300283
YEMELIANOV, V S YEVSTYUKHIN, A I	301626
(MOSCOW INST OF ENG PHYSICS MOSCOW RUSSIA)	301626
METALLURGY AND METALLOGRAPHY OF PURE METALS	301626
GORDON + BREACH N Y (1962)	301626
YEREMENKO, V NAYDICH, Y	900211
AN INVESTIGATION OF THE WETTING BY LIQUID METALS OF SURFACES	900211
OF CERTAIN REFRACTORY METALS	900211
TRUDY SEMINARA PO ZHAROSTOYKIM MATERIALAM NO 4, 38 (1959)	900211
FTD-TT-62-1252	900211
YODA, E	600855
ANOMALOUS GROWTH OF MOO3 CRYSTALS	600855
J PHYS SOC JAPAN 15, NO 5, 821 (1960)	600855
PA 64, 9110 (1961)	600855
YOGANARASIMHAN, S RAD, C	200881
CRYSTALLOGRAPHIC DATA-TITANIUM DIOXIDE (BROOKITE) T102	200881
ANAL CHEM 33, 155 (1961)	200881
CA 55, 6096 (1961)	200881
YORK, D	301019
PROPERTIES OF EVAPORATED THIN FILMS OF SILICON OXIDE	301019
J ELECTROCHEM SOC 110, 271 (1963)	301019
YOUNG, R ZIEGLER, W	100205
(GEORGIA INST OF TECHNOLOGY ATLANTA GEORGIA)	100205
CRYSTAL STRUCTURE OF LANTHANUM NITRIDE	100205
J AM CHEM SOC 74, 5251 (1952)	100205
CA 47, 1456 (1953)	100205
YOUNG, W LYND, L MOHL, J LIBOWITZ, G	201567
X-RAY AND DENSITY STUDY OF NONSTOICHIOMETRY IN U OXIDES	201567
US AT ENERGY COMM NAA-SR-6765, (1962)	201567
CA 57, 164 (1962)	201567
ZADUMKIN, S	201849
AN ESTIMATION OF THE SURFACE ENERGY OF SOME CARBIDES AND	201849
NITRIDES HAVING CRYSTAL LATTICES OF THE NaCl TYPE	201849
POVERKHN YAVLENIYA V METAL I SPLAVAKH I IKH ROL V PROTSESSAKH	201849
POROSHKOVAYA MET AKAD NAUK UKR SSSR INST METALLOKERAM I SPETS	201849
SPLAVOV 1961, 51 (1961)	201849
CA 57, 11937 (1962)	201849
ZADUMKIN, S	300284
(KABARDINO-BALKARSK UNIV SSSR)	300284
SURFACE TENSION AND HEAT OF SUBLIMATION OF SILICON, GERMANIUM	300284
AND TIN	300284

SØVET PHYSICS SOLID STATE 1, 516 (1959)	300284
ZADUMKIN, S TAMBIEV, B	301020
SURFACE ENERGY AND HEAT OF SUBLIMATION OF RARE EARTH ELEMENTS	301020
UCH ZAP KABARDINØ-BALKARSK UNIV 1961, NØ 13, 46 (1961)	301020
CA 57, 15898 (1962)	301020
ZAIDEL, A PRØKØFEV, V RAISKII, S	300615
TABLES OF SPECTRUM LINES	300615
LØNDØN PERGAMØN PRESS (1961)	300615
CA 57, 1776 (1962)	300615
ZAJIC, V	601170
(INST NUCLEAR RES CZECH SCI PRAGUE CZECH)	601170
SPECIFIC HEAT AND THERMAL CØDUCTIVITY OF POWDERED URANIUM	601170
ØXIDE U3Ø8	601170
JADERNA ENERGIE 6, 200 (1960)	601170
CA 54, 19141 (1960)	601170
ZAKHARØVA, G MISHINA, D	301022
NIØBIUM AND ITS ALLØYS	301022
FTD-TT-62-1256	301022
TSVETNYE METALLY NØ 11, 55 (1959)	301022
CØTS NØ 59, 158 (1962)	301022
ZAKHARØVA, G PØPØV, I	301021
NIØBIUM AND ITS ALLØY-USE OF POWDER METALLURGY IN THE USSR	301021
METALLURGY IN THE USSR	301021
JPRS-15978	301021
NIØBIY I YEGØ SPLAVY, MØSCØW (1961)	301021
CØTS NØ 59, 154 (1962)	301021
ZAKHARØVA, M PRØKØSHKIN, D	201241
THE NI-MØ-CR SYSTEM	201241
IZVEST AKAD NAUK SSSR ØTDEL TEKH NAUK MET I TØPLIVØ 1961,	201241
NØ 4, 59 (1961)	201241
CA 56, 1260 (1962)	201241
ZALABAK, C	200988
(LEWIS RESEARCH CENTER CLEVELAND ØHIØ)	200988
THE MELTING PØINT OF TANTALUM CARBIDE AND OF TUNGSTEN	200988
TECH NØTE D-761 (1961)	200988
CA 55, 12217 (1961)	200988
ZALKIN, A	201258
(UNIV OF CALIF LIVERMØRE CALIF)	201258
THE BERYLLIDES OF TI, V, CR, ZR, NB, MØ, HF AND TA	201258
ACTA CRYST 14, 63 (1961)	201258
CA 56, 2066 (1962)	201258
ZALKIN, A BEDFØRD, R SANDS, D	201118
(UNIV OF CALIFØRNIA LIVERMØRE CALIFØRNIA)	201118
CRYSTAL STRUCTURES OF ZRBE5 AND ZRBE17	201118
ACTA CRYST 12, 700 (1959)	201118
CA 55, 18522 (1961)	201118
ZALKIN, A TEMPELTØN, D	100198
THE CRYSTAL STRUCTURES OF CEB4, THB4 AND UB4	100198
ACTA CRYST 6, 269 (1953)	100198
AECD 3080 UCRL-522 (1950)	100198
CA 47, 6729 (1953)	100198
NSA 5, 3083 (1951)	100198

ZALKIN, A	TEMPLETØN, D			601410
THE CRYSTAL STRUCTURES ØF CEB4 THB4 AND UB4				601410
AECØ 2762 NØV 22, (1949) JAN 4, (1950)				601410
NSA 4, 1415 (1950)				601410
ZALUBAS, R				601192
(NBS	WASH	DC)		601192
PRELIMINARY LIST ØF LEVELS AND G-VALUES FØR THE FIRST				601192
SPECTRUM ØF TH(THI)				601192
J RESEARCH NATL BUR STANDARDS 63A, 275 (1959)				601192
CA 54, 8274 (1960)				601192
NSA 14, 3997 (1960)				601192
ZAMYATINA, V	BEKASØVA, N			200986
(INST HETERØØRG CØMPDS	MØSCØW	RUSSIA)		200986
PØLYMERIC CØMPØUNDS ØF BØRØN				200986
USPEKHI KHIM 30, 48 (1961)				200986
CA 55, 12130 (1961)				200986
ZAREMBØ, Y				201449
(AT ENERGY		USSR)		201449
THERMØDYNAMICS ØF THE REDUCTIØN ØF THØRIUM DIOXIDE BY CALCIUM				201449
AT ENERGY (USSR) 11, 185 (1961)				201449
CA 56, 10997 (1962)				201449
ZEGLER, S				201647
(ARGØNNE NATL LABS	ARGØNNE	ILL)		201647
THE URANIUM-RICH END ØF THE URANIUM-ZIRCØNIUM SYSTEM				201647
US AT ENERGY CØMM ANL-6055, (1962)				201647
CA 57, 4121 (1962)				201647
ZEIDLER, E	KRAUT, D	SCHLAUBITZ, K	MUELLER, D	301627
(INST APPLIED PHYS MATLS	DRESDEN	GERMANY)		301627
SEVERAL PRØPERTIES ØF RHENIUM AND ITS MØLYBDENUM ALLØYS				301627
J LESS-CØMMØN METALS 4, 547 (1962)				301627
CA 58, 7672A (1963)				301627
ZELDES, N				100191
(HEBREW UNIV	JERUSALEM	ISRAEL)		100191
THE SPECTRUM ØF GADØLINIUM II				100191
PHYS REV 90, 413 (1953)				100191
CA 47, 9142 (1953)				100191
ZELDES, H	LIVINGSTØN, R			700971
(ØAK RIDGE NATL LAB	ØAK RIDGE	TENN)		700971
CHEMICAL PHYSICS				700971
ØRNL-3176				700971
NSA 15, 32075 (1961)				700971
ZELIKMAN, A	KISLYAKØV, I			701037
RARE METALS AND THEIR ALLØYS				701037
NP-TR-564				701037
NSA 15, 18525 (1961)				701037
ZELIKMAN, A	KREIN, Ø	NISELSON, L	IVANØVA, Z	201861
SEPARATIØN ØF TUNGSTEN AND MØLYBDENUM BY RECTIFICATIØN ØF				201861
THEIR CHLØRIDES				201861
ZH PRIKL KHIM 35, 1467 (1962)				201861
CA 57, 12210 (1962)				201861
ZHDANØV, G	ZHURAVLEV, N	STEPANØVA, A	UMANSKII, M	700731
(STATE UNIV MØSCØW	MØSCØW	USSR)		700731
CRYSTAL CHEMISTRY ØF METAL HEXABØRIDES				700731

KRISTALLOGRAFIYA 2, 289 (1957)	700731
CA 51, 14361 (1957)	700731
ZHDANOV, G ZHURAVLEV, N STEPANOVA, A UMANSKI, M	200835
X-RAY INVESTIGATIONS OF BORON COMPOUNDS WITH RARE EARTH METALS	200835
REDKIE METALLY I SPLAVY, TRUDY PERVOGO VSESoyUZ SOVESHCHANIYA	200835
P0 SPLAVAM REDKIKH METAL, AKAD NAUK SSSR,	200835
INST.MET IM AA BAIKOVA MOSCOW 1957, 366 (1960)	200835
CA 55, 3366 (1961)	200835
ZVINCHUK R A	301385
X-RAY STUDY OF THE POLYMORPHISM OF NIOBIUM PENTOXIDE	301385
KRISTALLOGRAFIYA 3, 744 (1958)	301385
CA 53, 12785C (1959)	301385
ZHELANKIN, V KUTSEV, V ORMONT, B	201911
FORMATION OF HAFNIUM CARBIDE IN THE REDUCTION OF HF02 WITH	201911
CARBON	201911
ZH NEORGAN KHIM 7, 1762 (1962)	201911
CA 57, 14689 (1962)	201911
ZHELANKIN, V KUTSEV, V ORMONT, B	300557
EQUILIBRIUM STUDY OF THE REDUCTION OF HF02 BY CARBON	300557
AT HIGH TEMPERATURE	300557
ZH FIZ KHIM 35, 2608 (1961)	300557
BHT NO 2, 53 (1962)	300557
ZHUKOVSKII, V VLIASOV, V LFREDEV, A	201982
ELECTRICAL PROPERTIES OF THE URANIUM-OXYGEN SYSTEM IN THE	201982
U308-U02 COMPOSITION INTERVAL	201982
FIZ METAL I METALLOVED 14, 319 (1962)	201982
CA 58, 1975 (1963)	201982
ZHUKOVSKII, V M TKACHENKO, E V VLASOV, V G	301628
PHASE TRANSFORMATIONS DURING REDUCTION OF U409	301628
FIZ METAL I METALLOVED 15, 210 (1963)	301628
CA 58, 10967A (1963)	301628
ZHURAKOVSKII, E VAINSHTEIN, E	201226
(K D USHINSKII PEDAGOG INST ODESSA RUSSIA)	201226
COMPARATIVE STUDY OF THE FINE STRUCTURE OF THE X-RAY	201226
EMISSION BANDS FOR THE K BETA GROUP OF METALLIC TITANIUM	201226
AND FOR ITS COMPOUNDS WITH SOME LIGHT ELEMENTS	201226
DOKLADY AKAD NAUK SSSR 129, 1269 (1959)	201226
CA 56, 1053 (1962)	201226
ZHURAVLEV, N ET AL	300379
X-RAY DIFFRACTION DETERMINATION OF THE THERMAL EXPANSION	300379
COEFFICIENTS OF HEXABORIDES	300379
KRISTALLOGRAFIYA 6, NO 5 791 (1961)	300379
RUSS ACC 14, NO 10 2643 (1962)	300379
ZHURAVLEV, N MAKORENKO, G SAMSONOV, G SINELNIKOVA, V	300549
TSEBULYA, G	300549
PROPERTIES AND CONSTITUTION OF PHASES IN B-C ALLOYS	300549
IZV AKAD NAUK SSSR OID TECH NAUK MET I TOPLIVO	300549
NO 1, 133 (1961)	300549
BHT NO 2, 47 (1962)	300549
CA 55, 19698 (1961)	300549
NS 15, 17343 (1961)	300549
ZHURAVLEV, N STEPANOVA, A	700727
IM V LOMONOSOV STATE UNIV MOSCOW USSR)	700727

STRUCTURE OF SCB2	700727
KRISTALLOGRAFIYA 3, 83 (1958)	700727
CA 52, 9705 (1958)	700727
ZHURAVLEV, N STEPANOVA, A PADerno, Y SAMSONOV, G	201272
(M V LOMONOSOV STATE UNIV MOSCOW RUSSIA)	201272
DETERMINATION OF THE COEFFICIENT OF THERMAL EXPANSION	201272
OF HEXABORIDES BY X-RAY ANALYSIS	201272
KRISTALLOGRAFIYA 6, 791 (1961)	201272
CA 56, 2965 (1962)	201272
ZIEGLER, W YOUNG, R FLOYD, A	100196
(GEORGIA INST OF TECHNOLOGY ATLANTA GEORGIA)	100196
THE CRYSTAL STRUCTURE AND SUPERCONDUCTIVITY OF LANTHANUM	100196
J AM CHEM SOC 75, 1215 (1953)	100196
CA 47, 5207 (1953)	100196
ZIMAKOV, I SPITSYN, V	300684
THE EFFECT OF THE ENERGY OF A RADIO-ACTIVE EMITTER	300684
ON THE EVAPORATION RATE OF A SOLID	300684
DOKL AKAD NAUK SSSR 141, NO 6, 1400 (1961)	300684
NSA 16, 9452 (1962)	300684
ZIMMERER, R MIZUSHIMA, M	600920
PRECISE MEASUREMENT OF THE MICROWAVE ABSORPTION FREQUENCIES	600920
OF THE OXYGEN MOLECULE AND THE VELOCITY OF LIGHT	600920
PHYS REV 121, NO 1, 152 (1961)	600920
PA 64, 837 (1961)	600920
ZINTL, E MORAWIETZ, W GASTINGER, E	300149
BORON MONOXIDE	300149
Z ANORG U ALLGEM CHEM 245, 8 (1940)	300149
AEC-TR-4355 FOR OAK RIDGE BY TECH LIB RES SERVICE	300149
NSA 15, 8795 (1961)	300149
ZUBENKO, Y SOKOLSKAYA, I	201676
TUNGSTEN CARBIDE WORK FUNCTION	201676
ZH TEKHN FIZ 32, 378 (1962)	201676
CA 57, 4157 (1962)	201676
ZWIKKER, C	700508
PHYSICAL PROPERTIES OF TUNGSTEN AT HIGH TEMPERATURES	700508
PHYSICA 5, 249 (1925)	700508
CA 20, 1156 (1926)	700508
ZWIKKER, C SCHMIDT, G	700515
THE SPECIFIC HEAT OF TUNGSTEN BETWEEN 90 DEGREES AND 2600	700515
DEGREES K	700515
Z PHYSIK 52, 668 (1928)	700515
CA 23, 2080 (1929)	700515

IX
PROPERTY FILE

PROPERTY FILE CODE

ACT	ACTIVITY
BETA	COMPRESSIBILITY COEFFICIENT ($\text{BETA} = 1/V \cdot (DV/DP) T$)
BIB	BIBLIOGRAPHY
BOOK	BOOK
CEMP	CONDENSED PHASE, ELEC OR MAGNETIC PROP, EG WORK FUNC
COPT	CONDENSED PHASE, OPTICAL PROP.
CPH	HIGH TEMPERATURE HEAT CAPACITY
CPL	LOW TEMPERATURE HEAT CAPACITY
CRYS	CRYSTAL STRUCTURE
CTEX	COEFF OF THERMAL EXPANSION
DF	FREE ENERGY OF FORMATION, REACTION, ETC.
DH	HEAT OF FORMATION, REACTION, ETC
DHD	DISSOCIATION ENERGY
DHT	HEAT OF TRANSFORMATION
E	INTERNAL ENERGY
ELCH	ELECTROCHEMICAL
EMF	ELECTROMOTIVE FORCE
ENG	ENERGY LEVELS
ERES	ELECTRICAL RESISTIVITY
EXAPP	EXPERIMENTAL APPARATUS
EXPRO	EXPERIMENTAL PROBLEM
EXPTL	EXPERIMENTAL
EXTEC	EXPERIMENTAL TECHNIQUE
F	FREE ENERGY FUNCTION
H	HEAT CONTENT
KIN	KINETICS
MISC	MISCELLANEOUS
MPP	MISCELLANEOUS PHYSICAL PROPERTIES
MSP	MASS SPECTROMETRIC DATA
PHAS	PHASE DATA, MELTING, TRANSITION, BOILING TEMPS
PMCH	MECHANICAL PROPERTIES
PREP	PREPARATION OF MATERIAL
REAC	CHEMICAL REACTIONS
REV	REVIEW
RHO	DENSITY
S	ENTROPY
SPK	SPECTROSCOPIC DATA
SURF	SURFACE PROPERTIES
TCON	THERMAL CONDUCTIVITY
THEO	THEORY
THER	THERMODYNAMIC DATA
TRT	TRANSFORMATION TEMPERATURES
VAP	VAPORIZATION DATA
ZKP	EQ CONST

A

SPK	ACTINIDES		
CONNICK, R		49	400528
SPK	ACTINIDES		
BEDREAG, O		54	801014
THEO	ACTINIDES		
SCHENK, P		49	400578
THER	ACTINIDES		
ACKERMANN, R THORN		62	801815
CPL	AG		
BORELIUS, G		60	801168
DF	AG		
OVCHARENKO, O		61	800229
DH	AG		
VERHAEGEN, G			300236
VAP	AG		
YAMAMOTO, A S LUND		61	300230
VAP	AG		
KOVTUN, G KRUGLUKH		61	300733
THER	AIR		
HOCHSTIM, A		62	300898
THER	AIR		
HILSENATH, J KLEI		58	300312
THER	AIR		
KIVEL, B MAYER, H		54	800609
THER	AIR CARBON SYST		
SERGEYEV, V		61	400604
THER	ALK EARTHS		
EMLEY, E		52	100209
ERES	ALK EARTH BORIDES		
SAMSONOV, V		61	700587
DHT	ALK FLUORIDES		
PETIT, G DELBOVE		62	300785
DHD	ALK FLUORIDES		
BLUE, G GREEN, J		63	301191
DHT	ALK FLUORIDES		
PETIT, G DELBOVE,		62	300785
THER	ALK METALS		
EMLEY, E		52	100209
DH	ALK EARTH OXIDES		
MEDVEDEV, V		61	300336
DHD	ALK EARTH OXIDES		
VEITS, I GURVICH,		57	700965
DHD	ALK EARTH OXIDES		
MEDVEDEV, V		61	300336
THER	ALK EARTH OXIDES		
VEITS, I GURVICH,		57	700965
DH	ALK EARTH OXIDES		
MEDVEDEV, V		61	300263
DHT	ALLOYS		
BECK, P		60	201948
MISC	ALLOYS		
NOWOTNY, H		60	200917
PHAS	ALLOYS		
WALLACE, W		60	201731
REAC	ALLOYS		
ANDREEVA, V ALEKSE		62	201814
REAC	ALLOYS		
IOFFE, V BAGAEVA,		60	200837
REAC	ALLOYS		
FIELD, A AMMON, R		61	200950
REAC	ALLOYS		
MCKINSEY, C MINCHE		61	201949
SURF	ALLOYS		
KOZAKEVITCH, P URB		61	201557
TCON	ALLOYS		
BUDWORTH, D HOARE,		60	200802
THER	ALLOYS		
KAPUSTINSKII, A		60	200893
THER	ALLOYS		
MATSEEVA, M IVANOV		58	200892
DH	AL		
JOHNSON, R		56	801293
PHAS	AL		
JOHNSON, R		56	801293

VAP	AL		
JOHNSON, R		58	801293
CRYS	AL BE B SYST		
BECHER, H		62	201932
MSP	AL N		
LOWRIE, R		60	701014
THER	AL N		
MAH, A ET AL		61	300413
VAP	AL N		
LOWRIE, R		60	701014
VAP	AL N		
DREGER, L		62	300720
VAP	AL N		
DREGER, L DADAPE,		62	300604
SPK	AL O		
BECART, M		62	202001
SPK	AL O		
NICHOLLS, R		62	300698
CPH	AL2O 3		
CHEKHOVSKOI, V		62	701074
CPH	AL2O 3		
KANTOR, P LAZAREVA		62	300683
CPL	AL2O 3		
EDWARDS, J KINGTON		62	300823
DHT	AL2O 3		
KANTOR, P LAZAREVA		62	300683
REV	AL2O 3		
ALFRED, F		62	201893
CPH	AL2O 3		
DAWSON, R BRACKETT		63	202024
PHAS	AL2O 3		
DIAMOND, J SCHNEID		60	202028
PHAS	AL2O 3		
GIELISSE, P		62	201740
PHAS	AL2O 3		
ARAMAKI, S ROY, R		62	201895
CPH	APPARATUS		
KRAFTMACHER, IA		62	301281
REV	ATOMIC WEIGHTS		
CAMERON, A WICHES		61	301422
SPK	ATOMS		
ZAIDEL, A PROKOFEV		61	300615
THEO	ATOMS		
SLATER, J		62	600905
ENG	ATOMS		
CAUCHOIS, Y		55	301102

B

BIB	B		
SULLIVAN, R SEIBEL		60	701038
CEMP	B		
NIEMYSKI, I OLEMP		62	300705
CEMP	B		
HOOD, C THURSTON,		62	801694
CEMP	B		
SAMSONOV, G NESHPO		59	201052
CPH	B		
MCDONALD, R STULL,		62	300726
CPH	B		
WILLIAMS, N N		61	700659
CPH	B		
MAGNUS, A DANZ, H		28	700580
CRYS	B		
HORN, F		61	700969
CRYS	B		
HOARD, J		61	700998
CRYS	B		
BECHER, H SCHAFER,		60	400617
CRYS	B		
HUGHES, R KENNARD		63	300901
CRYS	B		
MALINCHKOV, O POVI		62	300948
CRYS	B		
MALYUCHKOV, O POVI		62	300584

CRYS B				TRT B			
KOLAKOWSKI	62	301508		DOLLOFF, R	60	600662	
CRYS B				VAP B			
CARPENTER, R KATO,	60	600626		KATHAYATE, Y RIHAN	63	301493	
CRYS B				VAP B			
KOHN, J NYE, W GA	60	600881		PAULE, R	61	601479	
DH B				VAP B			
ROBSON, H	58	300276		PRISELKOV, YU A SA	60	300142	
DH B				VAP B			
AKISHIN, P NIKITIN	59	300362		MARGRAVE, J	61	700967	
ERES B				VAP B			
HOOD, C THURSTON,	62	601694		KIBLER, G LYON, T	62	300427	
ERES B				VAP B			
SAMSONOV, G	61	700587		PAULE, R MARGRAVE	63	301320	
ERES B				VAP B			
TAYLOR, W ET AL	61	301802		PRISELKOV, Y SAPOZ	60	600637	
KIN B				PHAS B SYST			
SLEPTSOV, V SAMSON	60	200766		STEPANOVA, A UMANS	56	601204	
MISC B				SPK B SYST			
SAMSONOV, G	60	200916		STEPANOVA, A UMANS	56	601204	
MSP B				PHAS B AL SYST			
SHAPIRO, I WILSON,	61	201356		SEREBRYANSKII, V	61	300840	
PHAS B				CRYS B C			
HOOD, C THURSTON,	62	601694		KUDRYAVTSEVA, V SO	60	600789	
PHAS B				PHAS B C			
MARTIN, R SEAGLE,	61	300308		MARTIN, R SEAGLE,	61	300308	
PHAS B				REAC B C			
DOLLOFF, R	60	700989		LENZI, D PELLEGRIN	59	200865	
PHAS B				REAC B C			
BECHER, H	61	300343		NAZARCHUK, T	61	201578	
PHAS B				TRT B C			
TALLEY, C POST, B	60	200993		MARTIN, R SEAGLE,	61	300308	
REAC B				CEMP B 4C			
ELLIS, R	60	200980		SAMSONOV, G SYNELN	61	300386	
REAC B				REAC B 4C			
ROSENBERY, J	60	201392		BOSCH, F	62	202008	
REAC B				MPP B 4C			
GILLES, P	61	201334		PORTNOY, K SAMSONO	61	300485	
REAC B				REAC B 4C			
VEKSHINA, N MARKOV	62	201487		LYUTAYA, M NAZARCH	61	300526	
PHAS B				CRYS B 4C			
KOHN, J NYE, W GA	60	600881		EPELBAUM, V A SEVA	61	300202	
REAC B				REAC B 4C			
FISHER, F	60	200877		VUILLARD, G LUQUE	61	201467	
REAC H				PHAS B 4C SYST			
FEDEROV, T F SHAMA	60	300197		DOLLOFF, R	60	700989	
REAC B				CRYS B C SYST			
SAMSONOV, G MARKOV	60	300576		ELLIOTT, R VAN THY	60	701069	
REAC B				ERES B C SYST			
RUSIN, A TATEVSKII	61	301117		SAMSONOV, G	61	601585	
REAC B				MPP B C SYST			
HENDERSON, U	62	301469		KISLEY, P S SAMSON	60	300137	
REV H				MPP B C SYST			
WOHL, M	60	701053		ZHURAVLEV, N MAKAR	61	300549	
REV B				MSP B C SYST			
KOHN, J NYE, W GA	60	600881		VERHAEGEN, G STAFF	62	601660	
REV B				PHAS B C SYST			
WILLIAMS, D	60	201304		SAMSONOV, G	61	601585	
SPK B				PHAS B C SYST			
KRAEV, M	61	300798		ELLIOTT, R VAN THYN	60	600622	
SPK B				PHAS B C SYST			
PILCHER, G SKINNER	62	301044		ELLIOTT, R	61	700718	
SPK B				PHAS B C SYST			
RUSIN, A TATEVSKII	61	300580		DOLLOFF, R	60	700989	
SPK B				PHAS B C SYST			
MALTSEV, A KATAEV,	60	600701		ZHURAVLEV, N MAKAR	61	300549	
SPK B				PHAS B C SYST			
KRAEV, M	61	301068		DOLLOFF, R	60	600662	
THER B				THER B C SYST			
SCHICK, H ANTHROP	63	300994		SAMSONOV, G	59	201343	
THER B				REV B C SYST			
SULLIVAN, R SEIBEL	60	701038		ELLIOTT, R THYNE	60	600673	
THER B				VAP B C SYST			
SAMSONOV, G MARKOV	60	301118		VERHAEGEN, G STAFF	62	301609	
THER B				THER B C SYST			
WILLIAMS, N N	61	700659		VERHAEGEN, G STAFF	62	601660	
TRT B				THER B C SYST			
MARTIN, R SEAGLE.	61	300308		VERHAEGEN, G STAFF	60	601574	

VAP	B C SYST				
VERHAEGEN, G STAFF		60	601674		
DH	B F 3				
GALCHENKO, G TIMOF		60	201644		
REAC	B 2F 4				
HOLLIDAY, A TAYLOR		62	201724		
CPH	B N				
WALKER, B EWING, C		62	301098		
CPH	B N				
PROPHET, H STULL		63	300961		
CPH	B N				
MCDONALD, R STULL,		61	300333		
DH	B N				
GALCHENKO, G KORMI		60	201646		
KIN	B N				
SAMSONOV, G SLEPTS		60	201816		
CPH	B N				
MAGNUS, A DANZ, H		26	700660		
CRYS	B N				
THOMAS, J WESTON		62	301039		
CRYS	B N				
WENTORF, R		61	700936		
DH	B N				
WISE, S		62	300741		
DH	B N				
HILDENBRAND, D L		61	300219		
H	B N				
MEZAKI, R TILLEUX		62	601617		
KIN	B N				
SLEPTSOV, V SAMSON		69	200766		
PHAS	B N				
WENTORF, R		61	700936		
PHAS	B N				
WANG, C		62	301376		
VAP	B N				
HILDENBRAND, D HAL		63	301241		
VAP	B N				
FESENKO, V BOLGAR		63	301216		
PREP	B N				
TAGAWA, H ITOUJI		62	201936		
PEAC	B N				
SAMSONOV, G KOVALC		63	900221		
REV	B N				
SAMSONOV, G SEMENO		62	300682		
S	B N				
MEZAKI, R TILLEUX		62	601617		
SPK	B N				
REDFIELD, D BAUM		61	200978		
THEO	B N				
SAMSONOV, G KOVALC		63	900221		
VAP	B N				
HILDENBRAND, D HAL		63	202060		
REAC	B N				
BOSCH, F		62	202006		
THER	B N				
HILDENBRAND, D L		61	300219		
THER	B N				
FUGET, C R MASL, J		67	300243		
TRY	B N				
THOMAS, J WESTON		62	301039		
VAP	B N				
AKISHIN, P KHODEEV		62	300692		
VAP	B N				
FESENKO, V		62	300711		
VAP	B N				
DREGER, L DADAPE,		62	300604		
VAP	B N				
DREGER, L		62	300720		
VAP	B N				
DREGER, L		61	300628		
VAP	B N				
DREGER, L MARGRAVE		60	600642		
VAP	B N				
JENSEN, A GOSHGART		62	301266		
THER	B N SYST				
SAMSONOV, G		69	201343		
ERES	B N SYST				
SAMSONOV, G		61	601686		
PHAS	B N SYST				
SAMSONOV, G		61	601686		
SPK	B O				
KUZYAKOV, Y TATEVS		60	301066		
E	B O				
LAGERQVIST, A NILS		58	600702		
REAC	B O				
ZINTH, E MORAWIETZ		40	300149		
SPK	B O				
KUZYAKOV, Y TATEVS		60	600694		
SPK	B O				
SINGH, N		49	600703		
SPK	B O				
WELTNER, W WARN, J		62	300688		
SPK	B O				
MALTSEV, A KUZYAKO		57	300316		
SPK	B O				
KASHAR, W ET AL		61	300403		
DH	B O 2				
RUSIN, A TATEVSKII		63	202126		
SPK	B O 2				
JOHNS, J		62	300816		
DH	B 20				
GALCHENKO, G KORN		60	700916		
SPK	B 20 2				
SOMMER, A WHITE, D		63	202141		
SPK	B 20 2				
SOMMER, A WHITE, D		63	202141		
SPK	B 20 3				
AKISHIN, P VILKOV		62	301167		
SPK	B 20 3				
SOMMER, A WHITE, D		63	202141		
COPT	B 20 3				
MARKIN, E SOBOLEV,		61	700688		
CPH	B 20 3				
KRASOVITSKAYA, R K		61	700968		
CPH	B 20 3				
KRASOVITCHAYA, R M		61	300196		
CPH	B 20 3				
KRASOVITSKAYA, R K		61	300336		
CRYS	B 20 3				
MACKENZIE, J		61	600882		
CRYS	B 20 3				
MACKENZIE, J CLAUS		61	700616		
DH	B 20 3				
BERKOWITZ, J CHUPK		59	700893		
DH	B 20 3				
GALCHENKO, G KORN		59	300673		
DH	B 20 3				
ANON		61	300228		
H	B 20 3				
KRASOVITSKAYA, R K		61	700968		
MSP	B 20 3				
BERKOWITZ, J CHUPK		59	700893		
PHAS	B 20 3				
GIELLISSE, P ROCKE		60	601673		
PHAS	B 20 3				
MACKENZIE, J CLAUS		61	700616		
SPK	B 20 3				
LOWRIE, R		61	700966		
SPK	B 20 3				
TATEVSKII, V KOPTE		61	300384		
SPK	B 20 3				
MALTSEV, A MATVEEV		61	300949		
SPK	B 20 3				
MALTSEV, A A TETE		61	700604		
THER	B 20 3				
BERKOWITZ, J CHUPK		59	700893		
VAP	B 20 3				
HILDENBRAND, D HAL		63	301470		
VAP	B 20 3				
FIRSOVA, L NESEMEY		60	200761		
VAP	B 20 3				
NESMEYANOV, A FIRS		60	600632		
VAP	B 20 3				
LOWRIE, R		61	700943		
VAP	B 20 3				
FIRSOVA, L NESMEYA		60	701004		

VAP	B 20 3			PHAS	BA W O SYST		
NIKITIN, O AKISHIN		62	300964	PURT, G		62	301255
VAP	B 20 3			SIB	BE		
GIELLISSE, P ROCKE		60	601673	WOHL, M		60	700723
REAC	B 60			SIB	BE		
RIZZO, H SIMMONS		62	601671	ANON		60	700716
THEO	B O SYST			REV	BE		
KROGH-MOE, J		63	301288	SIEMS, P		63	301362
THER	B O SYST			SIB	BE		
MARGRAVE, J		61	301631	GUILL, J WORONCOW		59	601580
SPK	B O SYST			SIB	BE		
GREENE, F		61	201357	CARROLL, K		60	700662
VAP	B O SYST			CEMP	BE		
FIRSOVA, L NESMEYA		60	201020	CORNWELL, J		61	700667
VAP	B O SYST			CPH	BE		
NESMEYANOV, A FIRS		59	201019	JOSHI, S MITRA, S		60	200767
PHAS	B O SYST			CPH	BE		
NADOR, B		60	200938	BEAVER, W OROURKE		59	700933
SPK	B O SYST			CPH	BE		
MATVEEV, V MALTSEV		61	300775	KANTOR, P KRASOVIT		60	700955
SPK	B O SYST			CPH	BE		
KASKAN, W MACKENZI		61	600700	WALKER, B EWING, C		62	301098
VAP	B O SYST			CPH	BE		
SCHICK, H ANTHROP		63	300994	KANAZARVA, E PACKE		58	600628
VAP	B O SYST			CPH	BE		
SCHICK, H ANTHROP		62	300995	WILLIAMS, N N		61	700659
REAC	B O C SYST			CPL	BE		
RENTZEPI, P WHITE		59	300971	JOSHI, S MITRA, S		60	200767
DM	B O F SYST			CRYS	BE		
FARBER, M		62	201616	ANON		61	700932
THER	B O F SYST			CRYS	BE		
MAGEE, E		61	201611	BAKAKIN, V BELOV		62	201714
MSP	B O H SYST			CRYS	BE		
SHOLETTE, W PORTER		63	300988	FOUNFELKER, R SIET		62	701089
PHAS	B O H SYST			CTEX	BE		
ABRIKOSOV, N LIANG		60	300848	BEAVER, W OROURKE		59	700933
VAP	B O H SYST			CTEX	BE		
WHITE, D WALSH, P		59	300885	MEYERHOFF, R SMITH		62	300809
VAP	B O H SYST			DM	BE		
ABRIKOSOV, N LIANG		60	300848	GOLDSMITH, A HIRSC		60	700930
MISC	B SI SYST			ELCH	BE		
COLTON, E		61	700609	PROPIN, R		61	201031
MPP	B SI SYST			ERES	BE		
WILLIAMS, E		61	300805	MARTIN, A BUNCE, J		62	301079
REAC	B SI SYST			ERES	BE		
COLTON, E		61	700609	BRIDGMAN, P		51	400533
CRYS	B SI C SYST			H	BE		
PORTNOI, K SAMSONO		60	300144	KANTOR, P KRASOVIT		60	700955
ERES	B SI C SYST			KIN	BE		
PORTNOI, K SAMSONO		60	300144	GREGG, .		61	201244
PHAS	B SI C SYST			MPP	BE		
PORTNOI, K I SAMSO		60	300144	KAUFMANN, A GORDON		50	600129
PHAS	B SI C SYST			PHAS	BE		
MEERSON, G DERGUNO		61	300373	GOLDSMITH, A HIRSC		60	700930
REAC	B SI C SYST			PHAS	BE		
SAMSONOV, G SOLONN		60	200894	PICKETT, J LEVINE		62	601587
SPK	BA			PHAS	BE		
PENKIN, N SHABANOV		62	601601	PAINE, R CARRABINE		60	201197
CEMP	BA B 6			PHAS	BE		
LAFFERTY, J		50	400641	AMONENKO, V IVANOV		62	301124
DM	BA O			PHAS	BE		
HOLLOWAY, H		62	300626	AMONENKO, V IVANOV		61	300635
DM	BA O			PHAS	BE		
MAH, A		63	202093	MANNAS, D SMITH, J		62	201786
E	BA O			PMCH	BE		
LAGERQVIST, A HULD		64	600681	AMONENKO, V PAPIRO		62	300685
PHAS	BA O			REAC	BE		
ROTH, R WARING, J		61	201406	HOOPER, E KEEN, N		60	200947
REAC	BA O			REAC	BE		
LEONOV		61	301622	BASCHE, M SHETKY		60	201132
VAP	BA O			REAC	BE		
NIKONOV, B P OTMAK		61	300264	GREGG, S		61	201244
VAP	BA O			REAC	BE		
METSON, G		63	301636	GREGG, S		61	201133
DND	BA OXIDES			REAC	BE		
VEITS, I GURVICH		58	700964	DARRAS, R		62	301433
THER	BA OXIDES			REAC	BE		
VEITS, I GURVICH,		58	700964	HIGGINS, J ANTILL		62	201606

REV	BE				
ANON		63	301397		
REV	BE				
WOHLL, M		60	701053		
REV	BE				
HODGE, W		61	700859		
REV	BE				
MOURET, P RIGAUD		58	201527		
SPK	BE				
CODLING, K		61	600775		
SPK	BE				
JOHANSSON, L		62	601624		
SPK	BE				
SHKLVAREVSKII, I		61	201326		
SURF	BE				
EREMENKO, V NIZHEN		60	200821		
TCON	BE				
BEAVER, W OROURKE		59	700933		
THER	BE				
WILLIAMS, N N		61	700659		
THER	BE				
BARRIAULT, R DREIK		62	300865		
THER	BE				
CHERKASKIN, Y GLAD		57	301107		
TRT	BE				
GELLES, S PICKETT		60	600867		
VAP	BE				
FRANZEN, J HINTENB		61	700970		
VAP	BE				
GOLDSMITH, A HIRSC		60	700930		
VAP	BE				
HANLIN, H		60	700951		
VAP	BE				
NIKITIN, O GOROKHO		61	700692		
PHAS	BE B				
MARKEVICH, G MARKO		60	201315		
REAC	BE B 2				
MARKOVSKII, L		62	301530		
REAC	BE B 2				
MARKEVICH, G MARKO		60	700937		
CRYS	BE B 12				
BECHER, H		60	201128		
SPK	BE2				
HAMPSON, R DOOLING		60	201753		
REAC	BE4B				
BECHER, H SCHAEFER		62	301405		
CRYS	BE5B				
MARKEVICH, G KONDR		60	600830		
CRYS	BE B SYST				
SANDS, D E CLINE		61	700558		
PHAS	BE B SYST				
HOENING, C CLINE,		61	700691		
REAC	BE B SYST				
MARKEVICH, G MARKO		61	700917		
PHAS	BE B O SYST				
RASE, D		60	600872		
REAC	BE2C				
MARKOVSKII, L		62	301530		
THER	BE2C				
SCHICK, H ANTHROP		63	301579		
THER	BE2C				
MURATOV, F NOVOSEL		62	601602		
ZKP	BE2C				
MURATOV, F S NOVOS		59	300182		
CRYS	BE CA				
BAKER, T		62	201513		
DM	BE CL2				
THOMPSON, C SINKE		62	201817		
MPP	BE COMPOUNDS				
SHUBERT, J		60	701036		
REAC	BE COMPOUNDS				
SHUBERT, J		60	701036		
PHAS	BE C SYST				
MURATOV, F NOVOSEL		61	300771		
REAC	BE F 2				
EVSTYUKHIN, A		59	200852		
SPK	BE F 2				
OBUKHOV-DENISOV, V		60	200912		
SPK	BE F 2				
KUTYRKIN, V PEIZUL		57	201203		
CRYS	BE MG				
BAKER, T		62	201513		
PHAS	BE MO SYST				
ARZHANYI, P		59	200822		
THER	BE3N 2				
SCHICK, H ANTHROP		63	301580		
VAP	BE3N 2				
GREENBAUM, M YATES		62	301231		
BIB	BE O				
ANON		61	700928		
CPH	BE O				
VICTOR, A DOUGLAS		63	301372		
REAC	BE O				
MURATOV, F NOVOSEL		63	301309		
REAC	BE O				
KOMAREK, K COUCOUL		63	301269		
CPH	BE O				
GREENBAUM, M YATES		62	301231		
THER	BE O				
BLAUER, J GREENBAU		63	301190		
CPH	BE O				
KANDYBA, V KANTOR		60	700893		
CPH	BE O				
WALKER, B EWING, C		62	301098		
CRYS	BE O				
AUSTERMAN, S		63	201996		
MPP	BE O				
ROTHMANN, A		62	202122		
CPH	BE O				
KANDYBA, V V KANTO		60	700833		
CPH	BE O				
MAGNUS, A DANZ, H		28	700560		
CPL	BE O				
ASLANIAN, J CAILLA		61	201193		
CRYS	BE O				
BUDNIKOV, P DELYAE		60	701043		
CRYS	BE O				
MILLER, K		60	700952		
CRYS	BE O				
KULESHOV, I SADIKO		62	300770		
CRYS	BE O				
BUDNIKOV, P SHISHK		61	300470		
CRYS	BE O				
SMITH, D CLINE, C		62	701073		
CRYS	BE O				
AUSTERMAN, S		62	701072		
CRYS	BE O				
AUSTERMAN, S BELIN		63	301127		
CRYS	BE O				
BELLAMY, B BAKER		62	201930		
CTEX	BE O				
MILLER, K		60	700952		
OF	BE O				
BUDNIKOV, P DELYAE		60	701043		
DM	BE O				
BUDNIKOV, P DELYAE		60	701043		
DM	BE O				
SMIRNOV, M CHUKREE		58	700523		
ERES	BE O				
BUDNIKOV, P DELYAE		60	701043		
H	BE O				
BUDNIKOV, P DELYAE		60	701043		
H	BE O				
RODIGINA, E GOMELS		61	700966		
H	BE O				
KANDYBA, V KANTOR		60	700893		
KIN	BE O				
NAKATA, M		60	200855		
MISC	BE O				
BENTLE, G		62	301130		
MPP	BE O				
RILEY, W MCCLELLAN		62	301080		
MPP	BE O				
BUDNIKOV, P DELYAE		60	701043		
MPP	BE O				
ANON		61	700715		

MPP	BE O			THEO	BOILING TEMP		
GUZMAN, I POLYBOYA		62	300894	RICHARDSON, D		38	700817
MPP	BE O			THEO	BOND ENERGY		
AUSTERMAN, S		61	201320	JAFFEE, H ZUNG, V		61	301480
PHAS	BE O			THER	BONDING		
ANON		61	700715	SEIGEL, B		63	301380
PHAS	BE O			THEO	BONDS		
BAKER, T BALDOCK,		62	300641	SEIGEL, S SEIGEL		63	301358
PHAS	BE O			BOOK	BONDS		
BUDNIKOV, P DELYAE		60	701043	MORTIMER, C		63	301307
PHAS	BE O			THEO	BONDS		
MASSAZZA, F		61	201293	DURAKOV, V BATSANO		61	300753
PHAS	BE O			REV	BOOK		
SMITH, D CLINE, C		62	701073	BUNDY, F STRONG, H		62	201719
PHAS	BE O			THER	BOOK		
AUSTERMAN, S		62	701072	SCHMIDT, E		60	200814
REAC	BE O			THER	BOOK		
AUSTERMAN, S		63	301400	SUSHKOV, V		60	200816
REAC	BE O			THER	BOOK		
EDWARDS, P HAPPEL		62	301136	GERASIMOV, YA KRES		60	300207
SPK	BE O			CRYE	BORIDES		
DURIG, J LORD, C		62	201989	ARONSSON, B STENBE		59	201388
REV	BE O			REAC	BORIDES		
CHERON, T		61	301429	KOVALCHENKO, M SAM		60	201044
REV	BE O			REAC	BORIDES		
BUDNIKOV, P DELYAE		60	701043	MEYERSON, G		55	300571
SPK	BE O			REV	BORIDES		
THRUSH, B		60	200961	ARONSSON, B		61	700586
SPK	BE O			TCON	BORIDES		
PARKINSON, W NICH		59	600612	LVOV S		61	300937
SPK	BE O			THEO	BORIDES		
VEITS, I GURVICH		57	600899	BURG, A		60	300418
TCON	BE O			THEO	BORIDES		
BUDNIKOV, P DELYAE		60	701043	ROBINS, D		60	600624
TCON	BE O			THER	BORIDES		
ADAMS, M		54	600961	MEYERSON, G		55	301122
THER	BE O			DH	BORIDES		
KANDYBA, V V KANTO		60	700633	WILSON, F			300309
THER	BE O			CEMP	BORIDES		
BUDNIKOV, P DELYAE		60	701043	GOODMAN, P HOMONOF		61	301480
THER	BE O			CEMP	BORIDES		
BELYKH, L NESMEYAN		59	700918	SCLAR, N		61	300682
THER	BE O			DH	BORIDES		
ANON		61	700715	MASLOV, P		63	202099
THER	BE O			CEMP	BORIDES		
BARRIAULT, R DREIK		62	300866	SILVER, A KUSHIDA		63	300987
VAP	BE O			CRYE	BORIDES		
BUDNIKOV, P DELYAE		60	701043	STER, D MCKENNA		60	200830
VAP	BE O			CRYE	BORIDES		
BELYKH, L NESMEYAN		59	700918	MELINCHKOV, O POVI		62	300947
VAP	BE O			CRYE	BORIDES		
SEMENENKO, K KURDY		61	300838	SAMSONOV, G VAINSH		62	300628
VAP	BE O			CTEX	BORIDES		
FIRSOVA, L NESMEYA		60	701004	ZHURAVLEV, N STEPA		61	201272
VAP	BE O			DHD	BORIDES		
FIRSOVA, L NESMEY		60	200761	SHULISHOVA, O		62	301587
PHAS	BE2O3			MPP	BORIDES		
GIELISSE, P		62	201740	VAHLIDIEK, F MERSOL			301607
CEMP	BE OXIDES			MPP	BORIDES		
PALGUEV, S NECEIMI		62	201717	MARKOVSKII, L KOND		57	300941
VAP	BE OXIDES			MPP	BORIDES		
NESMEYANOV, A FIRS		59	201019	MORDIKE, R		60	300503
VAP	BE OXIDES			PHAS	BORIDES		
FIRSOVA, L NESMEYA		60	201020	STADELMAIER, H YUN		62	301594
REAC	BE O SYST			PHAS	BORIDES		
GREGG, S HUSSEY, R		60	200870	PORTNGY, K		60	700944
REAC	BE O SI SYST			REAC	BORIDES		
SUPOVA, E KELER, E		60	201573	LYUTAYA, M NAZARCH		61	300626
PHAS	BE TI O SYST			REAC	BORIDES		
SHCHEPOCHKINA, N		58	200958	LAFFERTY, J		51	400649
THER	BIMETALLICS			REV	BORIDES		
FASOLINO, L		63	301215	EICK, H		61	301439
THEO	BINARY			MPP	BORIDES		
GIESSEN, B GRANT		63	301226	THOMPSON, R		63	202146
THER	BINARY SYST			ERES	BORIDES		
VECHER, A GERASIMO		63	202161	SAMSONOV, G PADERN		62	202127
VAP	BINARY SYST			REAC	BORIDES		
YARYM-AGAIEV, N KOG		62	300700	MARKOVSKII, L		63	202088

MPP	BORIDES		
LVOV, S	NEMCHENKO	63	202090
REAC	BORIDES		
HOYT, E W	CHORNE	60	300246
MISC	BORIDES		
STRASHINSKAYA, L		62	201790
MPP	BORIDES		
FITZGERALD, L		63	301217
REV	BORIDES		
EMRICH, B		62	301182
THER	BORIDES		
OLIVER, R	BAIER, R	63	301314
PHAS	BORIDES		
GORELIK, S	ELYVTIN	62	201947
REAC	BORIDES		
MARKOVSKII, L	VEKS	62	201986
SPK	BORIDES		
MIKHAILOV, B	SHCHEG	62	900213
CRYS	BORIDES-PT METALS		
ARONSSON, B	RUNDQV	62	300504

C

VAP	C		
BAUN, W	HODGSON, F	63	202000
CRYS	C		
AUST, R	DRICKAMER	63	301176
THER	C		
ACKERMANN, R	THORN	58	601208
SIB	C		
NIGHTINGALE, R		62	701071
SIB	C		
CHEN, M		62	301428
CEMP	C		
SAMSONOV, G	NESHPO	59	201062
CEMP	C		
GUMENYUK, V	LEBEDE	61	700553
CPH	C		
RASOR, N	MCCLELLAN	60	700984
CPH	C		
VICTOR, A		62	300558
CPH	C		
RASOR, N	MCCLELLAN	60	700896
CPH	C		
LUCKS, C	DEEM, H	60	601691
CPH	C		
WILLIAMS, N N		61	700559
CRYS	C		
NIGHTINGALE, R		62	701071
CTEX	C		
RASOR, N	MCCLELLAN	60	700984
DH	C		
BAKER, C	KELLY, A	62	300524
DH	C		
DAVIS, A		60	600880
DHD	C		
LINDHOLN, E		64	600714
DHT	C		
BUNDY, F		63	300859
DHT	C		
TITOVA, V	FUTERG	62	301040
ERES	C		
COHAN, N	PUGH, D	63	301431
ERES	C		
GUMENYUK, V	LEBEDE	61	700553
MPP	C		
RASOR, N	MCCLELLAN	60	700896
MPP	C		
KLEIN, C		62	300915
PHAS	C		
BUNDY, F		62	300854
PHAS	C		
FUNKE, V	NOVIKOVA	62	201704
PHAS	C		
NIGHTINGALE, R		62	701071

PHAS	C		
STRONG, H		61	301599
REAC	C		
ENGELKE, J	HALDEN	60	201529
SPK	C		
COLLIGAN, G	GALASS	61	600860
SPK	C		
PUGH, H	LEES, J B	61	600842
SPK	C		
LOWRIE, R		62	601596
SPK	C		
PILCHER, G	SKINNER	62	301044
TCON	C		
RASOR, N	MCCLELLAN	60	700984
TCON	C		
RASOR, N	MCCLELLAN	60	700896
TCON	C		
GUMENYUK, V	LEBEDE	61	700553
THEO	C		
CROWELL, A		62	300701
THER	C		
RASOR, N	MCCLELLAN	60	200980
THER	C		
WILLIAMS, N N		61	700859
THER	C		
BARRIAULT, R	DREIK	62	300865
VAP	C		
COLLIGAN, G	GALASS	61	600860
VAP	C		
DAVIS, A		60	600880
VAP	C		
DOERNENBURG, E	HIN	61	700864
VAP	C		
KRIEGER, F		62	300931
VAP	C		
LOWRIE, R		62	601596
DHD	C 2		
BREWER, L	HICKS, W	62	300813
DHD	C 2		
BREWER, L	HICKS, W	62	300813
SPK	C 2		
STEELE, D		63	301595
SPK	C 2		
LOWRIE, R		62	601596
VAP	C 2		
BREWER, L	HICKS, W	62	300813
VAP	C 2		
BREWER, L	HICKS, W	62	300813
VAP	C 2		
LOWRIE, R		62	601596
E	C 3		
GOUPIL, R		53	600884
REAC	C 3		
CABANNES, F		56	300827
SPK	C 3		
CABANNES, F		56	301121
SPK	C 3		
BREWER, L	ENGELKE	62	300797
SPK	C 3		
CLEMENTI, E	MCLEAN	62	300814
SPK	C 3		
BREWER, L	ENGELKE	62	300797
SPK	C 3		
DORNENBURG, E	HINT	61	300467
VAP	C 3		
SHPIRLAYN, E	ASINO	62	300567
SPK	C 4		
CLEMENTI, E		61	300815
DH	C N		
BERKOWITZ, J		62	301407
SPK	C N		
MOORE, C	BROIDA, H	57	600687
SPK	C N		
KIESS, C		49	600686
SPK	C N		
DOUGLAS, A	ROUTLEY	54	600682
SPK	C N		
DOUGLAS, A		55	600679

SPK	C N			VAP	CA		
	CARROLL, P	56	600677		KOCHEROV, P GELD	59	300462
SPK	C N			CEMP	CA B 6		
	PANNETIER, G MARSI	61	600851		LAFFERTY, J	50	400541
DHD	C O			CEMP	CA B 6		
	BRACKETT, T	58	600708		JOHNSON, R DAANE	63	301489
DHD	C O			CTEX	CARBIDES		
	DOUGLAS, A MOLLER	55	600708		KRIKORIAN, N WALLA	63	202083
DHD	C O			CEMP	CARBIDES		
	HOWELL, H	49	600712		BONDARENKO, B ERMA	62	202007
DHD	C O			CEMP	CARBIDES		
	TOENNIES, J GREENE	57	600600		GOODMAN, P HQMO:OF	61	301460
SPK	C O			CEMP	CARBIDES		
	LOEWENSTEIN, E	60	600919		KUBASCHENSKI, O	56	601642
DHD	C O			THER	CARBIDES		
	LINDHOLN, E	54	600714		OLIVER, R BAIER, R	63	301314
E	C O			MPP	CARBIDES		
	TOBIAS, I FALLON	60	600695		FITZGERALD, L	63	301217
E	C O			CPH	CARBIDES		
	ROSENBLUM, B NETHE	57	600723		KRIKORIAN, O	62	301111
MPP	C O			CRYS	CARBIDES		
	ROSENBLUM, B NETHE	58	600724		EPPRECHT, W	61	301109
SPK	C O			CRYS	CARBIDES		
	HERZBERG, HUGO, T	56	600711		ATOJI, M	61	701070
SPK	C O			CRYS	CARBIDES		
	GOLDBERG, L MULLER	53	600710		ATOJI, M	62	201983
SPK	C O			CRYS	CARBIDES		
	BURRUS, C	58	600707		KOVALSKII, A	59	201131
SPK	C O			CTEX	CARBIDES		
	BEDARD, F GALLAGHE	53	600705		BELIKOV, A	60	201066
SPK	C O			DF	CARBIDES		
	BARROW, R GRATZER	56	600704		ANON	54	400618
SPK	C O			MISC	CARBIDES		
	RANK, D EASTMAN, D	61	600835		STRASHINSKAYA, L	62	201790
SPK	C O			MPP	CARBIDES		
	BARROW, R	61	600777		MORDIKE, B	60	300503
SPK	C O			PHAS	CARBIDES		
	MILLS, I THOMPSON	53	600715		KOVALSKII, A	59	201131
SPK	C O			PHAS	CARBIDES		
	KISHKO, S	60	300798		GORELIK, S ELYVTIN	62	201947
SPK	C O			REAC	CARBIDES		
	ONAKA, R	57	600716		SAMSONOV, G YASINK	61	100180
SPK	C O			REAC	CARBIDES		
	PALIK, E RAO, K	56	600717		SAMSONOV, G IASINS	61	300340
SPK	C O			REAC	CARBIDES		
	PLYLER, E ALLEN, N	58	600718		KOPYLOVA, V	61	201305
SPK	C O			SPK	CARBIDES		
	PLYLER, E BENEDICT	52	600719		BELIKOV, A	60	201066
SPK	C O			SURF	CARBIDES		
	PLYLER, E BLAINE	56	600721		ZADUMKIN, S	61	201849
SPK	C O			TCON	CARBIDES		
	RANK, D GUENTHER	57	600722		RUDY, E BENESOVSKY	60	200808
SPK	C O			TCON	CARBIDES		
	SUN, N WEISSLER, E	56	600725		LVOV, S	61	300937
SPK	C O			THEO	CARBIDES		
	TANAKA, Y JURAA, A	57	600726		ROBINS, D	60	600624
SPK	C O			THER	CARBIDES		
	MCCULLOH, K GLOCKL	53	600727		KUBASCHENSKI, O	56	601642
SPK	C O 2			THER	CARBIDES		
	SUN, N WEISSLER, E	55	600725		KUTSEV, V	62	300358
SPK	C O SYST			CRYS	CA C 2		
	KNIFE, R GORDON, A	56	600713		ZELDES, H LIVINGST	61	700971
KIN	C O SYST			CRYS	CA C 2		
	GULBRANSEN, E	63	301465		VANNERBERG, N	61	201300
MPP	C NI CO SYST			CRYS	CA C 2		
	YASUSHI KOJIMA SAN	61	300189		VANNERBERG, N	62	300598
CPH	CA			CRYS	CA C 2		
	FAVSTOVA, D IPPOLI	61	201613		ATOJI, M MEDRUD, R	59	601210
PHAS	CA			CRYS	CA C 2		
	BEREZHNOI, A KORDY	62	201553		ATOJI, M	61	700864
REAC	CA			CRYS	CA C 2		
	GREGG, S JEPSON, W	61	201062		TAGAWA, H FUJIMORI	60	201379
REAC	CA			CRYS	CA C 2		
	NORMAN, J	60	200868		BREDIG, M	61	201323
REAC	CA			KIN	CA C 2		
	KHLEBNIKOV, G SIMA	61	201625		TAGAWA, H SUGAWARA	62	201839
SPK	CA			TRT	CA C 2		
	CODLING, K	61	600775		JUZA, R SCHUSTER	61	600840

CPH	CA F 2			THEO	CALORIMETRY		
JOSHI, S	MITRA, S	60	200767	DENCE, W		63	301211
CPL	CA F 2			CPH	CALORIMETRY		
JOSHI, S	MITRA, S	60	200767	MITKINA, E		62	301308
TCON	CA F 2			THEO	CALORIMETRY		
SLACK, G		61	201126	SKURATOV, S M		61	300251
PHAS	CA MN SI O SYST			DH	CA COMPOUNDS		
GLASSER, F		62	201741	SHCHUKAREV, S MORO		62	300698
EMF	CA O			CEMP	CA O SYST		
BENZ, R	WAGNER, C	61	700640	PALGUEV, S NECEIMI		62	201717
PHAS	CA O			DHD	CA O SYST		
COCCO, A		59	201168	VEITS, I	GURVICH	56	700964
THEO	CA O			THEO	CA O SYST		
SCHICK, H	ANTHROP	62	300996	VEITS, I	GURVICH	56	700964
TRT	CA O			PHAS	CA O NB SYST		
SCHNEIDER, S		63	301348	IBRAHIM, M NORMAN		62	201876
REAC	CA O			EMF	CA SI O SYST		
RYABCHIKOV, I	MIKU	62	301336	BENZ, R	WAGNER, C	61	700640
VAP	CA O			MPP	CB C		
BABELIOWSKY, T	BOE	63	301179	NORTON, J	MOWRY, A	49	300157
VAP	CA O			CRYS	CD		
BABELIOWSKY, T		63	301178	LAWLEY, A		60	200801
VAP	CA O			CPH	CE		
BABELIOWSKY, T	BOE	62	301128	ARAJ, S	COLVIN, R	62	300751
E	CA O			CPH	CE		
LAGERQVIST, A	HULD	54	600681	ARAJ, S	COLVIN, R	62	301078
ERES	CA O			CPH	CE		
COCCO, A	BARBARIOL	62	301430	KOENIGSBERG, E	KEL	53	601002
MISC	CA O			CPH	CE		
LADD, M	LEE, W	60	201322	SPEDDING, F	MILLER	51	601241
MSP	CA O			CPH	CE		
BABELIOWSKY, T		62	301403	JAEGE, R	BOTTEMA	36	900102
MSP	CA O			CPL	CE		
BABELIOWSKY, T	BOE	62	301128	WILKINSON, M	CHILD	61	601412
PHAS	CA O			CPL	CE		
COCCO, A	VIRDIS, P	61	201316	GOODMAN, B		52	100208
PHAS	CA O			CPL	CE		
JUZA, R	SCHUSTER	61	600840	PARKINSON, D	H SIM	51	400557
PHAS	CA O			CTEX	CE		
BRCIC, B	GOLIC, L	62	201636	ANDRES, K		63	301172
PHAS	CA O			CPL	CE		
BAKER, E	BUTLER, J	62	201794	PARKINSON, D	ROBER	57	601151
REAC	CA O			CRYS	CE		
LEONOV, A		61	301522	SCHUCH, A	STURDNAN	50	400518
SPK	CA O			CRYS	CE		
ORTENBERG, F		61	300795	WEINER, R	RAYNOR	59	200871
SPK	CA O			CRYS	CE		
ROSEN, B	WENIGER	62	301561	MCHARGUE, C	YAKEL	60	600846
SPK	CA O			CTEX	CE		
LAGERQVIST, A		54	600883	DASHKOVSKII, A	SAV	61	201865
SPK	CA O			DHT	CE		
HULDT, L	LAGERQVIS	55	600893	CAVALLERO, U		43	700895
SPK	CA O			DHT	CE		
HULDT, L	LAGERQVIS	56	600894	KOVIMA, T	KIKUCHI	53	100183
SPK	CA O			ERES	CE		
HULTIN, M	LAGERQVI	51	600898	JAEGE, R	BOTTEMA	36	900102
SPK	CA O			ERES	CE		
VEITS, I	GURVICH	57	600899	JAMES, N	LEGNOLD	52	100206
SPK	CA O			ERES	CE		
GAYDON, A		55	600900	BRIDGMAN, P		51	400533
SPK	CA O			ERES	CE		
LAGERQVIST, A		53	600925	SPEDDING, F	DAANE	57	601066
VAP	CA O			ERES	CE		
METSON, G		63	301636	GOODMAN, B		52	100208
CPH	CALORIMETRY			H	CE		
WELTY, J	WICKS, C	62	301619	SPEDDING, F	MILLER	51	601241
CPH	CALORIMETRY			MPP	CE		
WITTIG, F		61	301624	IONOV, N	MITTSEV	61	601411
DH	CALORIMETRY			PHAS	CE		
KOLESOV, V	ZENKOV	62	300766	WERNER, R	RAYNOR	59	601359
DH	CALORIMETRY			PHAS	CE		
VASILEV, Y	SOBOLEV	62	300767	WILKINSON, M	CHILD	61	601412
DH	CALORIMETRY			PHAS	CE		
KOSOV, N	RIVIN, O	61	400590	KOVIMA, T	KIKUCHI	53	100183
THEO	CALORIMETRY			PHAS	CE		
SEMIKIN, I	KOSTOGR	61	900223	SPEDDING, F	DAANE	57	601066
THEO	CALORIMETRY			PHAS	CE		
BARNER, J		63	301181	LIVSHITS, L	GENSHA	62	301524

PHAS CE				CRYB CE B 6			
LIKHTER, A	57	601492		ZHDANOV, G ZHURAVL	57	601061	
PHAS CE				ERES CE B 6			
LIKHTER, A RYUBININ	58	601072		PADERNO, Y SAMSONO	61	301072	
PHAS CE				SPK CE B 6			
BEECROFT, R SWENSO	60	600669		TRONEVA, N MARCHUK	58	601157	
PHAS CE				DF CE C			
GONIKBERG, M SHAKH	57	601064		DANCY, E EVERETT	62	300878	
PHAS CE				THER CE CL2			
COLVIN, R ARAJS, S	61	600875		SENDEROFF, S MELLO	61	200930	
PHAS CE				THER CE CL3			
SPEDDING, F DAANE	57	700872		WALDEN, G SMITH, D	61	201414	
PHAS CE				VAP CE CL3			
VOGEL, R	17	900105		NOVIKOV, G BAEV, A	62	300698	
PHAS CE				SPK CE2			
CUBICIOTTI, D	49	900104		BURBRIDGE, G BURBR	64	600937	
PHAS CE				SPK CE2			
TROMBE, F FOEX, M	44	900118		ARROE, H	54	600859	
PHAS CE				DF CE C SYST			
ROLLA, L IANDELLI	43	900103		MCCABE, C	60	600835	
REAC CE				PHAS CE C SYST			
LORIER, J	49	400542		WARF, J PALENIK, G	60	600636	
RHO CE				THER CE F 3			
EICHELBERGER, J	61	601420		WESTRUM, E BEALE	59	600629	
SPK CE				REAC CE N			
GARSTANG, R	52	100207		SAMSONOV, G LYUTAY	63	301340	
SPK CE				ERES CE N			
BRIX, P FRANK, H	50	400526		DIDCHENKO, R GORTS	63	301435	
SPK CE				MPP CE N			
SMITH, K SPALDING	62	300777		SAMSONOV, G LYUTAY	62	301572	
SPK CE				CRYB CE N SYST			
SCHWARZSCHILD, M	57	601047		ANON	61	601376	
SPK CE				CRYB CE N SYST			
BURBRIDGE, E BURBR	55	601003		IANDELLI, A	37	601276	
SPK CE				ERES CE N SYST			
MURAKAWA, K ROSS	51	400556		DAOU, J	60	600815	
SPK CE				PHAS CE N SYST			
GRATTON, L	52	400567		EYRING, L SCHULDT	59	600634	
THER CE				VAP CE O			
PARKINSON, D H SIM	51	400557		KULVARSHAYA, B MAS	60	301064	
THER CE				PHAS CE O			
SPEDDING, F H MCKE	60	700570		EYRING, L HOLWBERG	62	601590	
THER CE				THER CE O			
SCHICK, H ANTHROP	62	300995		SCHICK, H ANTHROP	62	300995	
TRT CE				CPH CE O 2			
TROMBE, F FOEX, M	44	900118		KUZNETZOV, F A REZ	60	700537	
TRT CE				CPL CE O 2			
ROCHER, Y	62	301559		WESTRUM, E BEALE	61	300350	
TRT CE				CPL CE O 2			
JAEGER, F BOTTEMA	36	900102		WESTRUM, E BEALE	59	600629	
TRT CE				DH CE O 2			
GSCHNEIDER, K ELLI	61	202045		MUTHMANN, W WEISS	04	800144	
TRT CE				DH CE O 2			
ROLLA, L IANDELLI	43	900103		HIRSCH, A	11	900097	
TRT CE				ERES CE O 2			
CUBICIOTTI, D	49	900104		KEVANE, C	62	601467	
TRT CE				H CE O 2			
GSCHNEIDNER, K ELL	62	301464		KING, E CHRISTENSE	61	600826	
TRT CE				PHAS CE O 2			
KOVIMA, T KIKUCHI	53	100183		BRUNO, M	50	601385	
TRT CE				S CE O 2			
VOGEL, R	17	900105		KING, E CHRISTENSE	61	600826	
VAP CE				SPK CE O 2			
BEAVIS, L	60	600659		TRONEVA, N MARCHUK	58	601157	
REV CERAMICS				THER CE O 2			
RAMKE, W LATVA, J	63	202121		WESTRUM, E BEALE	59	600629	
REV CERAMICS				CPH CE20 3			
RYSHKEWITCH, E	63	301338		PANKRATZ, L KELLEY	63	301549	
BOOK CERAMICS				CPH CE20 3			
KINGIRY, W	60	301263		KUZNETSOVA, F A RE	61	700600	
CRYB CE B 4				CPL CE20 3			
ZALKIN, A TEMPELTO	53	100198		WELLER, W KING, E	63	301617	
CEMP CE B 6				CPL CE20 3			
SAMSONOV, G PADERN	59	300143		WESTRUM, E BEALE	61	300350	
CEMP CE B 6				DH CE20 3			
LAFFERTY, J	50	400541		HUBER, E HOLLEY, C	53	600963	
COPT CE B 6				DH CE20 3			
TSAREV, B ILLARION	63	301369		MAH, A	61	600889	

DM	CE2O 3			BIB	CR		
	KUZNETSOV, F REZUK	60	600690		WOHLL, M	60	700723
CRYS	CE2O 3			CPH	CR		
	COURTEL, R LORIER	50	400519		KRENTSIS, R P	61	300195
CRYS	CE2O 3			CPH	CR		
	HONIG, J	58	601531		KRAUSS, F	58	700647
ERES	CE2O 3			CPH	CR		
	HONIG, J	58	601531		JOHNSON, R	60	301488
PHAS	CE2O 3			CPL	CR		
	BRUNO, M	50	601385		BEAUMONT, R CHIHAR	60	200959
PHAS	CE2O 3			TRT	CR		
	HONIG, J	58	601531		ALLEN, B MAKKUTH	63	301169
REAC	CE2O 3			PHAS	CR		
	LEONOV, A RUDENKO	62	301521		GRIGORYEV, A SOKOL	61	301234
REV	CE2O 3			TRT	CR		
	HONIG, J	58	601531		WYDER, W HOCH, M	63	301383
SPK	CE OXIDES			CPL	CR		
	BRAUER, G GINGERIC	60	300559		DEWAR, J	13	700511
REV	CE OXIDES			CPL	CR		
	HONIG, J	58	600827		CLUSUIS, K FRANYOS	62	301051
THER	CE O SYST			CPL	CR		
	KUZNETSOV, F BELYI	61	300665		RICHARDS, T JACKSO	10	700565
MISC	CE O SYST			CRYS	CR		
	LORIER, J	49	400542		GRIGOREV, A SOKOLO	61	600653
DM	CE O SYST			CTEX	CR		
	BRAUER, K GINGERIC	60	300415		VASYUTINSKII, B KA	61	201416
DM	CE O SYST			ERES	CR		
	WALSH, P N DEVER,	61	700642		BRIDGMAN, P	51	400533
PHAS	CE O SYST			ERES	CR		
	EYRING, L SCHULDT	59	600634		MARCINKOWSKI, M LI	61	600861
PHAS	CE O SYST			PHAS	CR		
	BRAUER, G GINGERLI	57	600668		EDWARDS, A	60	200948
VAP	CB O SYST			PHAS	CR		
	BRAUER, K GINGERIC	60	300415		GRIGOREV, A SOKOLO	61	700620
REAC	CE SR O SYST			PHAS	CR		
	KELER, E GODINA, N	57	600866		MORIN, J	62	601571
ERES	CE ZR O SYST			REAC	CR		
	PALGUEV, S VOLCHEN	60	201074		DEUTSCH, N ERVIN	60	500123
BIB	CHEMISTRY			REAC	CR		
	HESLOP, R ROBINSON	62	301028		SILCOX, N DILLON	61	201734
REV	CHEMISTRY			REV	CR		
	MARGRAVE, J	62	300472		WOHLL, M	60	701053
REV	CHEMISTRY			SPK	CR		
	DROWART, J GOLDFIN	62	201917		ROSENZWEIG, N PORT	60	700996
THEO	CHEMISTRY			SPK	CR		
	HIRSCHFELDER, J	59	301474		BONNELLE, C	62	201754
DHD	CHLORIDES			SPK	CR		
	FEBER, R	63	301445		NEMNONOV, S MENSII	60	200977
PHAS	CO			THEO	CR		
	FUNKE, V NOVIKOVA	62	201704		ROSENZWEIG, N PORT	60	700996
VAP	CO			THEO	CR		
	SAXER, R	63	301576		ROSENZWEIG, N PORT	60	700901
VAP	CO			TRT	CR		
	VINTAIKIN, E TOMAS	61	300452		SVECHNIKOV, V	63	301601
TCON	CO F 2			TRT	CR		
	SLACK, G	61	201125		GRIGOREV, A SOKDOV	61	201437
PHAS	CO MO			VAP	CR		
	FORSYTH, J DALTE	62	201713		CANO, G	62	301423
CEMP	COMPOUNDS			VAP	CR		
	SAMSONOV, G SINELN	62	201968		GULBRANSEN, E ANDR	61	301074
CRYS	COMPOUNDS			VAP	CR		
	GLADISHEVSKII, E	61	201880		GULLBRANSEN, E AND	61	300465
REAC	COMPOUNDS			VAP	CR		
	NESPHOR, V	58	200896		HANLIN, H	60	700951
DK	COMPOUNDS			VAP	CR		
	MAKSIMOVA, I	62	202094		AMONENKO, V KRUGLY	61	300466
REAC	COMPOUNDS			VAP	CR		
	PAINE, R STONEHOUS	60	201631		IGNATOV, D LEBEDEV	61	301041
DHD	COMPOUNDS			VAP	CR		
	BRADY, P	60	301412		MIKHAILOV, G PRONI	61	300468
THEO	COMPOUNDS			CRYS	CR B		
	DROZIN, N	61	300534		MALINCHKOV, O POVI	62	300948
THER	CO P+			H	CR B		
	ORIANI, R MURPHY	62	201864		MEZAKI, R TILLEUX	62	601617
PHAS	CO TA			REAC	CR B		
	DRAGSDORE, R FORGE	62	201712		MARKOVSKII, L	62	301530
ERES	CO W C SYST			S	CR B		
	FUNKE, V SHURSHAKO	61	301453		MEZAKI, R TILLEUX	62	601617

MPP	CR B 2				
MALYUCHKOV, O POVI		62	202095		
CPH	CR B 2				
KRESTOVNIKOV, A VE		60	300672		
DF	CR B 2				
KRESTOVNIKOV, A VE		60	300672		
H	CR B 2				
MEZAKI, R TILLEUX		62	601617		
MPP	CR B 2				
SHCHERBAKOV, V VEY		60	300984		
PHAS	CR B 2				
NESHPOR, V KISLYI		59	700521		
REAC	CR B 2				
MARKOVSKII, L		62	301530		
REAC	CR B 2				
KOTSCH, H		60	301509		
S	CR B 2				
MEZAKI, R TILLEUX		62	601617		
THER	CR B 2				
BOLGAR, A		61	700938		
TRT	CR B 2				
NESHPOR, V KISLYI		59	700521		
VAP	CR B 2				
BOLGAR, A		61	700938		
CRYS	CR B 6				
EPELBAUM, V SEVAST		60	600800		
PHAS	CR B 6				
EPELBAUM, V SEVAST		60	600800		
REAC	CR2B				
MARKOVSKII, L		62	301530		
PHAS	CR3B 4				
ELFSTROM, M		61	300367		
CEMP	CR BORIDES				
LVOV, S NEMCHENKO		62	201981		
CEMP	CR 2 SYST				
CADEVILLE, M MEYER		62	202013		
CPH	CR B SYST				
KRESTOUNIKOV, A VE		59	200797		
CRYS	CR B SYST				
MALYUCHKOV, O POVI		62	300584		
CRYS	CR B SYST				
EPELBAUM, V SEVAST		57	700931		
MPP	CR B SYST				
MERZ, A KOTSCH, H		62	301301		
PHAS	CR B SYST				
EPELBAUM, V SEVAST		57	700931		
REAC	CR B SYST				
KOLOMYTSEV, P		58	300347		
REAC	CR B MO SYST				
TAI, S YOSINSKA, G		60	300272		
PHAS	CR B P SYST				
RUNDQVIST, S		62	300546		
PHAS	CR B2 MO SYST				
KOVALCHENKO, M SAM		60	300216		
PHAS	CR B2 MO SYST				
KOVALCHENKO, M SAM		60	300216		
CTEX	CR BE				
WHITE, G		61	201739		
MPP	CR C				
KOSOLAPOVA, T SAMS		62	300916		
REAC	CR C				
KOSOLAPOVA, T SAMS		62	300925		
REAC	CR C				
SAMSONOV, G KOSOLA		61	300555		
VAP	CR3C 2				
FESENKO, V BOLGAR		63	301216		
CRYS	CR3C 2				
MEINHARDT, D KRISE		60	700912		
THER	CR3C 2				
BOLGAR, A		61	700938		
THER	CR3C 2				
ANON		60	700992		
THER	CR3C 2				
ANON		60	700904		
THER	CR3C 2				
FUJISHIRA, S GOKCE		61	700615		
THER	CR3C 2				
FUJISHIRO, S GOKCE		61	201015		
VAP	CR3C 2				
ANON		60	700904		
VAP	CR3C 2				
BOLGAR, A		61	700938		
VAP	CR3C 2				
ANON		60	700992		
VAP	CR3C 2				
ANON		60	600566		
CEMP	CR CARBIDES				
LVOV, S NEMCHENKO		62	201981		
CEMP	CR CARBIDES				
LVOV, S NEMCHENKO		61	200968		
KIN	CR CARBIDES				
KOSOLAPOVA, T SAMS		61	200957		
THER	CR CARBONYLS				
KAWAI, K MURATA, H		60	200806		
DF	CR C SYST				
ALEKSEEVA, V		61	300201		
REAC	CR C SYST				
KOSOLAPOVA, T SAM		63	301275		
DF	CR C SYST				
VINTAIKIN, E		63	202155		
DF	CR C SYST				
ALEKSEEVA, V SHVAR		61	700632		
MPP	CR C SYST				
BURYLEV, B		61	301071		
PHAS	CR CO SYST				
GRIGOREV, A YEH, Y		60	201782		
PHAS	CR FE SYST				
GRIGOREV, A SOKOLO		60	600912		
THER	CR FE SYST				
KUBASCHEWSKI, O		60	600696		
THER	CR FE SYST				
WADA, H KAWAI, Y		61	700627		
THER	CR MO SYST				
LAFFITTE, M KUBASC		61	700626		
MPP	CR N				
SAMSONOV, G VERKHO		61	301573		
VAP	CR N				
SANO, K		55	300983		
MPP	CR N				
SAMSONOV, G VERKHO		62	300997		
PHAS	CR NB SYST				
MISENCAIK, J		60	201432		
PHAS	CR NB SYST				
PAN, V		61	201635		
PHAS	CR NB MO SYST				
GOLDSCHMIDT, H BRA		61	201069		
PHAS	CR NB MO SYST				
KURNANOV, N TRONEV		60	201338		
PHAS	CR NB MO SYST				
SVECHNIKOV, V KOBZ		61	201496		
PHAS	CR NB SI SYST				
GOLDSCHMIDT, H BRA		61	201070		
THER	CR NI SYST				
KUBASCHEWSKI, O DE		60	300211		
PHAS	CR NI NB SYST				
SVECHNIKOV, V PAN		61	201495		
CEMP	CR NITRIDES				
LVOV, S NEMCHENKO		62	201981		
CEMP	CR NITRIDES				
SAMSONOV, G		60	700947		
DH	CR NITRIDES				
SAMSONOV, G		60	700947		
MISC	CR NITRIDES				
POPOVA, U		61	201082		
MPP	CR NITRIDES				
VERKHOGLYADOVA, T		61	201355		
REV	CR NITRIDES				
SAMSONOV, G		60	700947		
DHD	CR O				
HULDT, L LAGERQVIS		52	600764		
DHD	CR O				
LAGERQVIST, A HULD		53	600765		
REAC	CR O				
TAKEKAZU, B HIROTA		61	201549		
SPK	CR O				
BERG, R SIMANOGLN		60	301089		

THEO	CR O		
BARRIAULT, R DREIK		62	300865
CRYS	CR O 2		
CLOUD, W SCHREIBER		62	201931
MPP	CR O 2		
SWABODA, T ARTHUR		61	700524
DK	CR O 2		
KUBATA, B		61	700586
REAC	CR O 2		
KUBATA, B		61	700586
THEO	CR O 2		
KUBATA, B		61	700586
THEO	CR O 2		
BARRIAULT, R DREIK		62	300865
S	CR O 3		
SPITSYN, V AFONSKI		60	300619
THEO	CR O 3		
BARRIAULT, R DREIK		62	300865
CRYS	CR2O 3		h
GRAHAM, J		60	600818
DF	CR2O 3		
JEANNIN, Y MANNERS		63	301483
PHAS	CR2O 3		
JAFFRAY, J		61	700655
REAC	CR2O 3		
SAMSONOV, G KOSOLA		61	300555
TRT	CR2O 3		
MCNALLY, R PETERS		61	600828
VAP	CR2O 3		
WANG, K DREGER, L		60	700897
VAP	CR2O 3		
CAPLAN, D COHEN, M		61	700529
VAP	CR2O 3		
KE CHING WONG DREG		60	300140
VAP	CR2O 5		
NEUGENAUER, J		63	301311
REAC	CR3O		
KIHLBORG, L		62	202088
MISC	CR OXIDES		
LUX, H EBERLE, L		61	700628
PHAS	CR OXIDES		
ANDERSSON, S		59	201178
PHAS	CR O SYST		
KUBOTA, T		61	600910
VAP	CR O SYST		
GLEMSE, O MUELLER		62	300759
PHAS	CR RU SYST		
SAVITSKII, E TEREK		61	300836
MISC	CR SALTS		
LUX, H EBERLE, L		61	700628
CPH	CR SI SYST		
GOLUTVIN, U LYAN		61	700540
DM	CR SI SYST		
GOLUTVIN, V LYAN		61	700540
DM	CR SI SYST		
GOLUTVIN, Y		62	301229
H	CR SI SYST		
GOLUTVIN, U LYAN		61	700540
THEO	CR SI SYST		
GOLUTVIN, U LYAN		61	700540
THEO	CRYSTAL		
DOYAL, B		61	300223
PHAS	CR TA SYST		
GRIGOREV, A SOKDOU		60	201646
THEO	CR TA SYST		
PILOYAN, G O EVSEE		60	300178
THEO	CR TA SYST		
PILOYAN, G EVSEEV		60	600688
PHAS	CR U O SYST		
SMITH, D CLEIN, C		61	201483
PHAS	CS NB O SYST		
REISMAN, A MINEO		61	201080
SIB	CU		
RICHERT, E BECKETT		49	700564
DM	CU		
VERHAEGEN, G			300236
MPP	CU		
RICHERT, E BECKETT		49	700564

REV	CU		
RICHERT, E BECKETT		49	700564

D

THEO	DIATOMIC GASES		
GUNGMAN, V		61	700548
THEO	DIATOMIC GASES		
ARAI, T		60	300842
THEO	DIATOMIC GASES		
BROUNSHTEIN, B YUR		62	300774
THEO	DIATOMIC GASES		
GURVICH, L YUNGMAN		60	300480
DHD	DIATOMIC MOLECULE		
SAYASOV, Y IVANOV		60	400593
REV	DIATOMIC MOLECULE		
HERZBERG, G		62	600536
SPK	DIATOMIC MOLECULE		
HOUGEN, J		62	300784
SPK	DIATOMIC MOLECULE		
FOGARASSY, B NEMET		60	200879
SPK	DIATOMIC MOLECULE		
HERZBERG, G		62	600536
THEO	DIATOMIC MOLECULE		
BROUNSHTEIN, B I		61	300187
THEO	DIATOMIC MOLECULE		
PAPOUSEK, D		61	700676
THEO	DIATOMIC MOLECULE		
LIPPINCOTT, E STEE		61	700683
SPK	DIATOMIC, 1ST ROW		
FROGA, S RANAIL, B		61	700644
THEO	DIATOMICS		
VANDERSLICE, J		62	202160
SPK	DIATOMICS		
NIKITIN, E		62	301312
DHD	DIATOMICS		
PRITCHARD, H		62	301554
DHD	DIATOMICS		
CLEMENTI, E		63	301204
SPK	DIATOMICS		
JENSOVSKY, L		62	301487
THEO	DIATOMICS		
RUE, R		63	301336
THEO	DIATOMICS		
RICE, O		62	301557
THEO	DIATOMICS		
SPIRIDONOV, V TATE		61	301592
THEO	DIATOMICS		
PAPOUSEK, D CERMAN		62	301550
MISC	DIBORIDES		
MARKOVSKII, L VEKS		61	201080
THEO	DIFFRACTION		
RAMBIDI, N SPIRIDO		62	301389
CEMP	DY		
LEGVOLD, S SPEDDIN		63	100189
CPL	DY		
DREYFUS, B		61	201220
CPL	DY		
GRIFFEL, M		56	601263
CPL	DY		
LOUNASMAA, O GUENT		62	300779
CPL	DY		
GRIFFEL, M SKOCHDO		56	601018
CRYS	DY		
KOEHLER, W WOLLAN		61	301804
CRYS	DY		
FOUNFELKER, R SIET		62	701089
DM	DY		
HUBER, E		56	601291
DM	DY		
SAVAGE, W HUDSON		56	601126
DM	DY		
WHITE, D		61	201217
ERES	DY		
COLVIN, R LEGVOLD		60	601389

ERES	DY		
LEGUOLD, S	SPEDDIN	53	100189
ERES	DY		
COLES, B		58	801498
SPK	DY		
DONTSOV, Y		58	801055
REAC	DY		
OLCESE, G		61	201802
SPK	DY		
AKIMOV, A		57	801099
SPK	DY		
MERRILL, P	GREENST	56	801007
SPK	DY		
SMITH, K	SPALDING	62	300777
CRYS	DY		
DARNELL, F	MOORE, E	63	202023
SPK	DY		
BURBRIDGE, E	BURBR	55	801003
SPK	DY		
MURAKAWA, K	KAMEI	53	801218
VAP	DY		
WHITE, D	WALSH, P	60	301822
VAP	DY		
WHITE, D	WALSH, P	61	300455
VAP	DY		
SAVAGE, W	HUDSON	59	801126
CEMP	DY B 6		
SAMSONOV, G	PADERN	59	300143
VAP	DY O		
KULVARSHAYA, B	MAS	60	301084
SPK	DY2		
BURBRIDGE, G	BURBR	54	800937
CPL	DY20 3		
WESTRUM, E	JUSTICE	63	301012
CPH	DY20 3		
PANKRATZ, L	KELLEY	63	301549
CRYS	DY20 3		
STARITZKY, E		56	801292
CTEX	DY20 3		
PLOETZ, G		57	801309
DH	DY20 3		
HUBER, E		56	801291
PHAS	DY20 3		
STARITZKY, E		56	801030

E

THEO	EFFUSION		
PRISLKOVA, Y	SAPOZ	60	300423
THEO	EFFUSION		
FIRSOVA, L		62	301448
THEO	EFFUSION		
SEARCY, A	SCHULZ	63	300980
CPL	EINSTEIN FUNCTION		
OVERTON, W	C HANCO	60	300244
BETA	ELEMENTS		
EGYED		54	700739
CPL	ELEMENTS		
SKIFFMAN, C		52	801836
DH	ELEMENTS		
NESMEYANOV, A	KHAN	60	800860
REAC	ELEMENTS		
RYABCHIKOV, D	SKLY	60	200787
REAC	ELEMENTS		
ROLSTEN, R		60	200786
REV	ELEMENTS		
SHARPE, A	SHARP, D	61	201831
SPK	ELEMENTS		
WATSON, R		60	200816
THEO	ELEMENTS		
GATES, D	THODOS, G	60	201372
VAP	ELEMENTS		
ORMONT, B		62	300785
VAP	ELEMENTS		
NESMEYANOV, A		61	300422

VAP	ELEMENTS		
HONIG, R		62	301144
ERES	ELEMENTS, GROUP 2		
VOROB, A	NAKHODN	58	201600
REAC	ELEMENTS, GROUP 4		
CHIANG, T		62	201680
THEO	ENTROPY		
DROZIN, N		61	300888
THEO	EQUILIBRIUM		
POE, A		63	301551
CEMP	ER		
LEGVOLD, S	SPEDDIN	53	100189
CRYS	ER		
KOEHLER, W	WOLLAN	61	301604
DH	ER		
TRULSON, O	HUDSON	61	800832
DH	ER		
WHITE, D		61	201217
ERES	ER		
COLVIN, R	LEGVOLD	60	801389
ERES	ER		
LEGUOLD, S	SPEDDIN	53	100189
ERES	ER		
COLES, B		58	801498
MPP	ER		
IONOV, N	MITTSEV	61	801411
SPK	ER		
SMITH, K	SPALDING	62	300777
SPK	ER		
JUDD, B	MARQUET, L	62	300801
SPK	ER		
AKIMOV, A		57	801099
VAP	ER		
WHITE, D	WALSH, P	60	301822
VAP	ER		
WHITE, D	WALSH, P	61	300455
CEMP	ER B 6		
SAMSONOV, G	PADERN	59	300143
VAP	ER O		
KULVARSHAYA, B	MAS	60	301084
CPL	ER20 3		
WESTRUM, E	JUSTICE	63	301012
CPH	ER20 3		
PANKRATZ, L	KING	63	202114
PHAS	ER20 3		
STARITZKY, E		56	801030
DH	EU		
TRULSON, O	HUDSON	61	800832
ERES	EU		
OLSEN, C		60	801336
PHAS	EU		
COLVIN, R	ARAJIS, S	61	800875
PHAS	EU IN O SYST		
SCHNEIDER, S		61	201537
SPK	EU		
SAKELLARIDIS, P		63	100184
SPK	EU		
VAN DIJKE	BEATTY, S	51	400548
SPH	EU		
BRIX, P		52	400566
SPK	EU		
BURBRIDGE, E	BURBR	55	801003
SPK	EU		
MERRILL, P	GREENST	56	801007
SPK	EU		
BRIX, P	KOPPERMAN	52	400574
SPK	EU		
BOHM	VITENSE, E	60	801169
CEMP	EU B 6		
SAMSONOV, G	PADERN	59	300143
CRYS	EU B 6		
FELTEN, E	BENDER	58	700857
CRYS	EU N		
EICK, H	BAENZIGER	56	801046
PHAS	EU N		
EICK, H	BAENZIGER	56	801046
REAC	EU N		
EICK, H	BAENZIGER	56	801046

REAC	EU NITRIDES		
EICK, H		57	601053
VAP	EU O		
KULVARSHAYA, B MAS		60	301054
SPK	EU2		
BURBRIDGE, G BURBR		54	600937
CTEX	EU2O 3		
PLOETZ, G		57	601309
MPP	EU2O 3		
CURTIS, C THARP, A		59	700804
MSP	EU2O 3		
PANISH, M		61	601372
TRT	EU2O 3		
WISNYI, L PIJANOWS		57	601056
VAP	EU2O 3		
PANISH, M		61	601372
CRYS	EU3O 4		
BAERNIGHAUSEN, H		62	701088
SPK	EU11		
DEUTSCH, A		56	600982
BIB	EU OXIDES		
JONES, P		60	200984
PHAS	EU OXIDES		
EICK, H BAENZIGER		56	601070
REAC	EU OXIDES		
EICK, H		57	601053
REAC	EU OXIDES		
EICK, H BAENZIGER		56	601070
MSP	EXPERIMENTAL		
LEHRLE, R		62	301520
MSP	EXPERIMENTAL		
MCDOWELL, C		62	201370
SPK	EXPERIMENTAL		
HEXTES, R		63	301240

F

BETA	FE		
KRUPNIKOU, K BAKAN		63	301149
THER	FE		
KINNE, G VISHKAREV		62	301147
VAP	FE		
FRANZEN, J HINTENB		61	700970
MPP	FE C SYST		
MORI, T AKETA, D		60	300206
THER	FE C SYST		
TSENG, C POLYAKOV		61	301003
THER	FE CO SYST		
SATO, T KACHI, S		56	300268
PHAS	FE CR SYST		
WADA, H KAWAI, Y		60	300289
DHD	FE O		
LAGERQVIST, A HULD		53	600765
PHAS	FE SI B SYST		
ARONSSON, B ENGSTR		60	201348
MPP	FE SI SYST		
DRETZE, H D BALTHE		61	300242
PHAS	FE TI C SYST		
PENG, R CHOV, Y		58	300269
THEO	FUSION		
FERRIER, A		62	300791
THEO	FUSION		
GROSSE, A LENTNER		62	300578

G

OH	GA		
GURVICH, L		60	600652
DHD	GAS METAL DIOXIDE		
BREWER, L ROSENBLA		61	700957
F	GAS METAL DIOXIDE		
BREWER, L ROSENBLA		61	700957

SPK	GAS METAL DIOXIDE		
BREWER, L ROSENBLA		61	700957
F	GASEOUS ATOMS		
KATZ, T MARGRAVE		55	600933
THER	GASEOUS IONS		
GREEN, J POLAND, D		60	200782
REV	GASES		
GLUSHKO, V		62	301221
THEO	GASES		
HIRSCHFELDER, J CU		54	202051
THEO	GASES		
HIRSCHFELDER, J		63	202052
BOOK	GASES		
PENNER, S		62	202117
THER	GASES		
MCDOWELL, R		63	301300
THEO	GASES		
PREDVODITELEV, A		63	301322
THER	GASES		
SEIGEL, B		63	301359
DHD	GASES		
MATLOW, S		61	300401
DHD	GASES		
LIPPINCOTT, E ET A		61	300402
SPK	GASES		
OPPENHEIM, I HAFEM		63	301316
MSP	GASES		
MARTYNKEVICH, G		62	3007357
SPK	GASES		
HOUGEN, J		62	301479
SPK	GASES		
WATANABE, K INN, E		52	600565
THEO	GASES		
GURVICH, L YUNGMAN		61	300354
THEO	GASES		
BROUNSHTEIN, B YUR		62	300364
THEO	GASES		
WATANABE, K INN, E		52	600565
THEO	GASES		
GODNEV, I ALEKASAN		62	300893
THEO	GASES		
VUKALOVICH, M ARTY		62	301005
THEO	GASES		
ALTUNIN, V		62	301395
THER	GASES		
SMITH, F		63	301590
THER	GASES		
BROUNSHTEIN, B YUR		62	301417
THER	GASES		
GURVICH, L V YUNG M		61	300248
THER	GASES		
BAIBUZ, V MEDVEDEV		61	300644
THER	GASES		
LAVROV, N FILIPPOV		59	300341
THER	GASES		
KOLSKY, H GILMER,		57	700838
THER	GASES		
TABACHENKO, A		62	900227
VAP	GASES		
GILLES, P		62	301142
VAP	GASES		
HONIG, R HOOK, H		60	300424
VAP	GA O		
KULVARSHAYA, B MAS		60	301054
VAP	GA O		
SHCHUKAREV, S SEME		61	300837
CEMP	GD		
LEGVOLD, S SPEDDIN		53	100189
CPL	GD		
LOUNASMAA,		63	301527
CPL	GD		
CRANE, L		62	300811
CRYS	GD		
FOUNFELKER, R SIET		62	701059
OH	GD		
TRULSON, O HUDSON		61	600932
CTEX	GD		
ANDRES, K		63	301172

DH	GD	61	201217
WHITE, D			
ERES	GD	60	601389
COLVIN, R	LEGVOLD,		
ERES	GD	53	100189
LEGVOLD, S	SPEDDIN		
ERES	GD	58	601498
COLES, B			
SPK	GD	54	601284
MURAKAWA, K			
SPK	GD	62	300777
SMITH, K	SPALDING,		
SPK	GD	57	601099
AKIMOV, A			
SPK	GD	52	100192
BUX, P	ENGLER, H		
SPK	GD	53	100191
ZELDES, N			
SPK	GD	55	601003
BURBRIDGE, E	BURBR		
SPK	GD	58	601007
MERRILL, P	GREENST		
SPK	GD	53	100190
SUWA, S			
SPK	GD	53	100184
SAKELLARIDIS, P			
SPK	GD	50	400540
RUSSELL, H			
SPK	GD	51	400563
BRIX, P	ENGLER, D		
SPK	GD	52	400566
BRIX, P			
SPK	GD	52	400567
GRATTON, L			
SPK	GD	52	400576
SUWA, S			
VAP	GD	60	301622
WHITE, D	WALSH, P		
VAP	GD	61	300455
WHITE, D	WALSH, P		
CRYS	GD B 4	58	601111
STEPANOVA, A	ZHURA		
CTEX	GD B 4	58	601111
STEPANOVA, A	ZHURA		
CAMP	GD B 6	59	300143
SAMSONOV, G	PADERN		
SPK	GD2	54	600937
BURBRIDGE, G	BURBR		
CPH	GD20 3	62	300958
PANKRATZ, L	KING		
CPL	GD20 3	63	300907
JUSTICE, B	WESTRUM		
CTEX	GD20 3	57	601308
PLOETZ, G			
DH	GD20 3	55	600930
HUBER, E	HOLLEY, C		
REAC	GD20 3	61	300387
KELER, E	GODINA, N		
TRT	GD20 3	57	601058
WISNYI, L	PIJANOWS		
SPK	GDII	56	600982
DEUTSCH, A			
BIB	GD OXIDES	60	200964
JONES, P			
CAMP	GE	61	301036
UNY, C			
MSP	GE		301103
KOYLOVSKAYA, V			
THER	GE	57	301107
CHERKASKIN, Y	GLAD		
VAP	GE	61	201208
VINTAIKIN, E			
DH	GE C SYST	60	200768
SCACE, R	SLACK, G		
PHAS	GE C SYST	60	200768
SCACE, R	SLACK, G		
PHAS	GE O	49	601634
BREWER, L	MASTIK		

MSP	GROUP III-IV-V	62	300471
AHEARN, A	THURMOND		
THER	GROUP IV-V-VI		

H

HOCH, M		62	300544
REAC	HARD METALS	63	301134
DEMPSEY, E			
REAC	HAFNATES	63	202078
KOMMISSAROVA, L	SP		
THER	HALIDES	63	202010
BREWER, L	SOMAYAJU		
DH	HALIDES	62	300702
BARBER, M	LINNETT		
REV	HALIDES	63	301416
BREWER, L	SOMAYAJU		
RHO	HALIDES	60	200897
KIRSCHENBAUM, A	CA		
THEO	HEAT CAPACITY	62	301471
HILSENATH, J	ZIEG		
THEO	HEAT CAPACITY	63	301218
FLINN, P	MARADUDIN		
THEO	HEAT CAPACITY	62	301291
LANDIHA, N			
CTEX	HEXABORIDES	61	300379
ZHURAVLEV, N	ET AL		
PHAS	HF	62	201988
BARITZKE, H	ASAI		
KIN	HF	62	601577
KUBASCHEWSKI, O			
THER	HF	62	601577
KUBASCHEWSKI, O			
BIB	HF	60	600649
ABSHIRE, E	NOTESTI		
BIB	HF	52	600903
CURTIS, C			
BIB	HF	52	600904
WILLIAMS, G	BAKER		
CPH	HF	60	601583
FIELDHOUSE, I	LANG		
CRYS	HF	60	201564
GLADYSHEVSKII, E	TY		
CRYS	HF	62	701089
FOUNFELKER, R	SIET		
CTEX	HF	60	601583
FIELDHOUSE, I	LANG		
CTEX	HF	61	600844
NOWOTNY, H	LAUBE		
MPP	HF	63	202064
KAREV, V	KLYUCHARE		
MISC	HF	61	200891
SPINK, D			
MPP	HF	60	601225
SKINNER, G	BECKETT		
PHAS	HF	60	200907
KORNILOV, I			
PHAS	HF	61	300308
MARTIN, R	SEAGLE		
PHAS	HF	60	201309
NOWOTNY, H	BRAUN		
REAC	HF	60	201829
ENGELKE, J	HALDEN		
CRYS	HF	63	301253
JAMIESON, J			
CPL	HF	63	301264
KNIEF, G	BETTERTON		
VAP	HF	63	301284
KRIKORIAN, O			
REV	HF	62	201787
SPERNER, H			
SPK	HF	61	300776
KLINKENBERG, P			
SPK	HF	58	601088
MOORE, C			

SPK	HF			DHD	HF C		
NORRIS, J		60	601194	BITTNER, H	GORETZK	62	301132
SPK	HF			MPP	HF C		
ROSENZWEIG, N	PORT	60	700901	ANON		61	300237
SPK	HF			MPP	HF C		
ROSENZWEIG, N	PORT	60	700996	SAMSONOV, G		59	300996
SPK	HF			MPP	HF C		
SHAW, C		55	600908	SAMSONOV, G	PADERN	61	201143
TCON	HF			PHAS	HF C		
FIELDHOUSE, I	LANG	60	601883	ANON		61	601599
THEO	HF			PHAS	HF C		
ROSENZWEIG, N	PORT	60	700996	BENESOVSKY, F	RUDY	60	700974
THEO	HF			MPP	HF C		
ROSENZWEIG, N	PORT	60	700901	PADERNO, V		62	202112
THER	HF			CEMP	HF C		
MARGRAVE, J		61	700967	SAMSONOV, G	FOMENK	63	202128
THER	HF			CEMP	HF C		
SCHICK, H	ANTHROP	63	300994	BITTNER, H	GORETZK	62	202004
TRT	HF			CEMP	HF C		
TAYLOR, A	DOYLE, N	61	600833	INGOLD, J		63	301251
TRT	HF			CTEX	HF C		
GIESSEN, B	RUMP, I	63	301455	KRIHORIAM, WALLA		63	301285
TRT	HF			PHAS	HF C		
MARTIN, R	SEAGLE	61	300308	COFFMAN, J	COULSON	61	701040
TRT	HF			PHAS	HF C		
GRESSEN, B	RUMP, I	62	300887	BENESOVSKY, E	RUDY	61	100181
VAP	HF			PHAS	HF C		
PANISH, M	REIF, L	63	300959	CURTIS, C	DONEY, L	54	300867
SPK	HF3			REAC	HF C		
KLINKENBERG, P	VAN	61	701019	MEERSON, G	KREIN	60	200831
SPK	HF4			REAC	HF C		
KLINKENBERG, P	VAN	61	701019	CALVERT, E	KIRK, M	62	301421
CEMP	HF B 2			REAC	HF C		
MATSKEVICH, T	KAZA	62	300952	SAMSONOV, G	PADERN	61	201143
CRYS	HF B 2			REAC	HF C		
RUDY, E		61	201255	ZHELANKIN, V	KUTSE	62	201911
H	HF B 2			TCON	HF C		
MEZAKI, R	TILLEUX	62	601617	LOWRIE, R		60	701014
KIN	HF B 2			THER	HF C		
ANON		62	601597	BOLGAR, A		61	700938
MPP	HF B 2			THER	HF C		
PADERNO, Y	B SEREL	59	700534	SCHICK, H	ANTHROP	63	301579
REAC	HF B 2			THER	HF C		
PADERNO, Y	B SEREL	59	700534	LITTLE, A		62	301528
S	HF B 2			VAP	HF C		
MEZAKI, R	TILLEUX	62	601617	VIDALE, G		61	301611
THER	HF B 2			VAP	HF C		
LITTLE, A		62	301526	BOLGAR, A		61	700938
VAP	HF B 2			VAP	HF C		
KRUPKA, M		62	601598	COFFMAN, J	COULSON	61	701040
PHAS	HF B C SYST			VAP	HF C		
NOWOTNY, H		61	201147	COFFMAN, J	COULSON	61	300293
PHAS	HF B C SYST			VAP	HF C		
NOWOTNY, H	RUDY, E	61	300190	SCHICK, H	ANTHROP	63	300994
PHAS	HF B N SYST			PHAS	HF C SYST		
RUDY, E	BENESOVSKY	61	300486	BENESOVSKY, F	RUDY	60	600648
PHAS	HF BA O SYST			PHAS	HF C SYST		
KELER, E	GODINA, N	61	201214	AVARDE, R	AUGUSTIN	62	300850
PHAS	HF BE SYST			REAC	HF C O SYST		
KRIPYAKEVICH, P	TY	61	201377	ZHELANKIN, V	KUTSE	61	300557
PHAS	HF B X			PHAS	HF CA OXIDES		
VICKERY, R	C MUIR	60	300232	GODINA, N	KELER, E	61	201336
TRT	HF B X			SURF	HF CARBIDES		
VICKERY, R	MUIR, H	60	300232	FOMENKO, V		61	201420
CEMP	HF C			PHAS	HF CA O SYST		
MATSKEVICH, T	KAZA	62	300952	KELER, E	GODINA, N	61	201214
CEMP	HF C			VAP	HF CL 4		
BONDARENKO, B	ERMA	62	301409	TOIRELNIKOV, V	KOM	61	301101
COPT	HF C			VAP	HF CL 4		
COFFMAN, J	COULSON	61	701040	EVSTYUKHIN, A	BARI	60	300882
CPH	HF C			THER	HF CL SYST		
LOWRIE, R		60	701014	RUZINOV, L	BELOV		301568
CRYS	HF C			CEMP	HF COMPOUNDS		
COFFMAN, J	COULSON	61	701040	LEWIS, C	R	61	300234
CRYS	HF C			OH	HF F 4		
BENESOVSKY, F	RUDY	60	700974	GREENBERG, E	SETTL	62	300739
DF	HF C			SPK	HF HALIDES		
COFFMAN, J	COULSON	61	701040	BUCHLER, A		60	201465

THF	HF HALIDES		
LUNGU, S		62	300736
PHAS	HF MG O SYST		
GODINA, N Keler, E		61	201336
PHAS	HF MO SYST		
KAUFMANN, A RAPPER		60	202066
PHAS	HF MO SYST		
KAUFMANN A R RAPPER		61	300218
THEO	HF N		
BAUGHAN, E		59	300866
MPP	HF N		
SAMSONOV, G VERKHO		62	300997
MPP	HF N		
SAMSONOV, G		59	300996
CEMP	HF NITRIDES		
SAMSONOV, G		60	700947
DH	HF NITRIDES		
SAMSONOV, G		60	700947
rev	HF NITRIDES		
SAMSONOV, G		60	700947
PHAS	HF O		
KORNILOY, I		60	200769
THF	HF O		
SCHICK, H ANTHROP		63	301679
VAP	HF O		
PANISH, M REIF, L		63	300969
CEMP	HF O 2		
MATSKEVICH, T KAZA		62	300962
CRYS	HF O 2		
ADAM, J ROGERS, M		59	300862
CTEX	HF O 2		
GRAIN, C CAMPBELL		61	601471
PHAS	HF O 2		
DELIMARSKY, Y BUDE		62	300880
VAP	HF O 2		
SHCHUKAREV, S SEME		63	301362
PHAS	HF O 2		
KELER, E GODINA, N		61	300264
PHAS	HF O 2		
CURTIS, C DONEY, L		54	300867
PHAS	HF O 2		
GRAIN, C CAMPBELL		61	601471
REAC	HF O 2		
MCTAGGART, F		61	300338
TRT	HF O 2		
WOLTEN, G		63	202161
CRYS	HF O 2		
KOFSTAD, P RUZICKA		63	202073
MPP	HF O 2		
MCTAGGART, F		63	202101
THF	HF O 2		
SCHICK, H ANTHROP		63	301680
PHAS	HF O 2		
LEFEVRE, J		63	301619
THF	HF O 2		
SCHICK, H ANTHROP		63	301679
TRT	HF O 2		
BAUN, W		63	201999
THF	HF O 2		
MCCLAIN, L		60	300278
TRT	HF O 2		
CURTIS, C DONEY, L		54	300867
VAP	HF O 2		
HASAPIS, A MELVEGE		61	701017
VAP	HF O 2		
HASAPIS, A MELVEGE		61	701039
PHAS	HF O SYST		
RUDY, E STECHER, P		63	300974
PHAS	HF O SYST		
KUBASCHEWSKI, O		62	601677
THF	HF O SYST		
SILVER, M FARRAR		63	202137
CRYS	HF O SYST		
DAGERHAMN, T		61	300478
THF	HF O SYST		
VEINBACHS, A KOMAR		62	601611
MPP	HF O F SYST		
BUSLAYEV, Y GORBUN		62	300830

CRYS	HF P		
JEITSCHKO, W NOWOT		62	301484
PHAS	HF RE SYST		
SAVITSKII, E TYLKI		62	201796
PHAS	HF RE SYST		
KAUFMANN A R RAPPER		61	300218
PHAS	HF SR O SYST		
KELER, E GODINA, N		61	201214
PHAS	HF TA C SYST		
NOWOTNY, H		63	301166
PHAS	HF TI O SYST		
GODINA, N Keler, E		60	201522
PHAS	HF U C SYST		
KRIKORIAN, N WITTE		63	301613
PHAS	HF U C SYST		
BENESOVSKY, F RUDY		61	301406
PHAS	HF W		
KAUFMANN A R RAPPER		61	300218
THF	HF X 4		
ALEKSANDROVSKAYA, A		63	301393
SPK	HG		
MCNALLY, J		52	100211
REV	HIGH TEMP CHEM		
GILLES, P		61	300460
CRYS	HO		
KOEHLER, W WOLLAN		61	301504
CPL	HO		
LOUNASMAA, O		62	701077
DH	HO		
WHITE, D		61	201217
ERES	HO		
COLVIN, R LEGVOLD		60	601389
SPK	HO		
SAKELLARIDIS, P		53	100184
VAP	HO		
WHITE, D WALSH, P		60	301822
VAP	HO		
DEMARIA, G GUIDO		63	202097
VAP	HO		
WHITE, D WALSH, P		61	301014
VAP	HO		
WAKEFIELD, G		62	300724
VAP	HO O		
KULVARSHAYA, B MAS		60	301064
CRYS	HO B 4		
STEPANOVA, A ZHURA		58	601111
CTEX	HO B 4		
STEPANOVA, A ZHURA		58	601111
CEMP	HO B 6		
SAMSONOV, G PADERN		59	300143
CPH	HO 20 3		
PANKRATZ, L KING		63	202114
CPL	HO 20 3		
WESTRUM, E JUSTICE		63	301012
REV	H. T RESEARCH		
GROSSE, A		63	301236

I

CPH	IN		
CARTER, W		61	601631
CTEX	IN		
CARTER, W		61	601631
THF	IN		
CARTER, W		61	601631
DH	INORGANIC COMPS		
REZNITSKII, L A		61	300260
SPK	INORGANIC COMPS		
OZIMOV, B VOLNOV		61	700691
DH	INORGANIC SALTS		
KARPACHEV, S V KAR		60	300138
THF	INORGANIC SALTS		
KARPACHEV, S V KAR		60	300138
S	INORGANIC SUBSTAN		
ACKERMANN, R J THO		58	300266

MPP	INTERMETALLICS				
	KOROLKOV, A IGUMNO	61	300538		
REV	INTERMETALLICS				
	PAINE, R STONEHOU	60	201391		
REAC	IONS				
	TALROZE, V	60	601643		
THER	IONS				
	GREEN, J POLAND, D	62	300353		
THER	IONS				
	GREEN, J POLAND, D	61	301482		
SIB	IR				
	GOODWIN, T	58	601547		
CEMP	IR				
	WHITE, G WOODS, S	57	601050		
CPH	IR				
	DOUGLASS, R HOLDEN	59	700375		
CPL	IR				
	JOHNSON, R HUDSON	58	601039		
CRYS	IR				
	MCCALDIN, J DUWEZ	54	600956		
CRYS	IR				
	THOMPSON J	62	201648		
OH	IR				
	PANISH, M REIF, L	61	700639		
OH	IR				
	HAMPSON, R WALKER	61	700681		
ERES	IR				
	BRIDGMAN, P	51	400533		
MPP	IR				
	FRANCIS, A	62	301076		
REV	IR				
	BETTERIDGE, W RHYS	62	202003		
PHAS	IR				
	MENDENHALL, C INGE	07	900143		
PHAS	IR				
	HENNING, F WENSEL	33	900128		
SPK	IR				
	DEODHAR, G PADALIA	62	300576		
SPK	IR				
	MOORE, C	58	601088		
SPK	IR				
	ROSENZWEIG, N PORT	60	700901		
SPK	IR				
	ROSENZWEIG, N PORT	60	700996		
SPK	IR				
	MURAKAWA, K SUWA	52	600942		
SPK	IR				
	ALBERTSON, W	38	900122		
SPK	IR				
	SEIMENS, W	53	600949		
TCON	IR				
	WHITE, G WOODS, S	57	601050		
TCON	IR				
	POWELL, R TYE, R	55	601082		
THEO	IR				
	ROSENZWEIG, N PORT	60	700996		
THEO	IR				
	ROSENZWEIG, N PORT	60	700901		
THER	IR				
	DOUGLASS, R HOLDEN	59	700375		
THER	IR				
	BARRIAULT, R DREIK	62	300865		
THER	IR				
	GOODWIN, T	58	601547		
TRT	IR				
	MCCALDIN, J DUWEZ	54	600956		
TRT	IR				
	MENDENHALL, C INGE	07	900143		
TRT	IR				
	HENNING, F WENSEL	33	900128		
VAP	IR				
	MARGRAVE, J	61	700967		
VAP	IR				
	HASAPIS, A PANISH	60	700994		
VAP	IR				
	DREGER, L	62	300720		
VAP	IR				
	DREGER, L	61	300528		
VAP	IR				
	DREGER, L MARGRAVE	60	600643		
VAP	IR				
	PANISH, M REIF, L	61	700639		
VAP	IR				
	HAMPSON, R WALKER	61	700681		
VAP	IR				
	PAULE, R	61	601479		
CRYS	IR B SYST				
	ARONSON, B STENBER	62	300767		
CRYS	IR B SYST				
	ARONSON, B ASELIUS	59	601166		
PHAS	IR C				
	NADLER, M KEMPTER	60	300301		
REAC	IR CL				
	STEPIN, B CHERNYAK	60	201576		
THER	IR O				
	BARRIAULT, R DREIK	62	300865		
CPH	IR O 2				
	JAEGER, F	34	900127		
CPH	IR O 2				
	WOHLER, L JOCHUM	33	900124		
CPH	IR O 2				
	WOHLER, L JOCHUM	33	900124		
DH	IR O 2				
	SCHNEIDERREITTI, G	62	301582		
DH	IR O 2				
	WOHLER, L WITZMANN	08	900126		
DH	IR O 2				
	BILTZ, W	34	900127		
DH	IR O 2				
	WOHLER, L JOCHUM	33	900124		
DH	IR O 2				
	WOHLER, L JOCHUM	33	900124		
VAP	IR O 2				
	CORDFUNKE, E MEYER	62	300572		
THER	IR2O 3				
	ALCOCK, C HOOPER	60	601161		
VAP	IR O SYST				
	CORDFUNKE, E MEYER	62	301054		
MISC	IR O SYST				
	HELVENSTON, E	60	601195		
THER	IR O SYST				
	SCHAFER, H JOACHIM	60	601160		

K

VAP	KNUDSEN				
	WINTERBOTTOM, W HI	62	300560		
VAP	KNUDSEN				
	VETRENKO, E MIKULI	62	300603		

L

CTEX	LA				
	ANDRES, K	63	301172		
THER	LA				
	MASLOV, P MASLOV	59	601196		
BETA	LA				
	BRIDGMAN, P	48	700883		
BETA	LA				
	BRIDGMAN, P	48	700884		
CPL	LA				
	PARKINSON, D H SIM	51	400557		
CPL	LA				
	BERG, J		700780		
CPL	LA				
	PARKINSON, D	51	700885		
CPL	LA				
	BERMAN, A ZEMANSKY	58	700886		
CPL	LA				
	BOORSE, H BERMAN	55	700887		

CPL	LA			CRY5	LA B 6		
	MONTGOMERY, H PELL	61	700910		ZHDANOV, G ZHURAVL	67	601061
CRY5	LA			CRY5	LA B 6		
	ZIEGLER, W YOUNG	63	100196		MALINCHKOV, O POVI	62	300948
CRY5	LA			CRY5	LA B 6		
	HERRMANN, K DAANE	66	700906		SAMSONOV, G GRODSH	66	700733
CTEX	LA			CRY5	LA B 6		
	DASHKOVSKII, A SAV	61	201866		TVOROGOV, N	69	700860
CTEX	LA			CRY5	LA B 6		
	BARSON, F LEGVOLD	66	700902		BERTAUT, F BLUM, P	62	700870
DHT	LA			CTEX	LA B 6		
	CAVALLERO, U	43	700896		ZHDANOV, G ZHURAVL	67	700731
ERES	LA			CTEX	LA B 6		
	ZIEGLER, W YOUNG	63	100196		KRIKORIAN, O	60	700847
ERES	LA			DH	LA B 6		
	COLVIN, R LEGVOLD	60	601389		SAMSONOV, G PADERN	61	700862
ERES	LA			MPP	LA B 6		
	ALSTAD, J COLVIN	61	201099		SAMSONOV, G	69	700846
ERES	LA			MPP	LA B 6		
	BRIDGMAN, P	61	400533		SAMSONOV, G NESHPO	69	700734
ERES	LA			VAP	LA B 6		
	JAMES, N LEGNOLD	62	100206		FESENKO, V BOLGAR	63	301216
H	LA			MPP	LA B 6		
	KEILEY, K	60	700891		KUDINTSEVA, G POPO	62	301289
MPP	LA			COPT	LA B 6		
	SPEDDING, F DAANE	61	700907		TSAREV, B ILLARION	63	301369
PHAS	LA			MPP	LA B 6		
	SPEDDING, F DAANE	67	700872		BLUM, P BERTAUT, F	64	700848
PMCH	LA			CEMP	LA BORIDE		
	SMITH, J CARLSON	67	700746		PADERNO, Y SAMSONO	60	200971
REAC	LA			CRY5	LA B SYST		
	LORIER, J	49	400542		MALYUCHKOV, O POVI	62	300684
S	LA			PHAS	LA B SYST		
	KELLEY, K	60	700891		JOHNSON, R DAANE	61	201106
SPK	LA			REAC	LA C		
	MURAKAWA, K	61	300826		SCAIFE, D WYLIE, A	68	700863
SPK	LA			CEMP	LA C 2		
	GARSTANG, R	62	100207		GREENWOOD, N OSBOR	61	201076
SPK	LA			CRY5	LA C 2		
	VAN DIJKE BEATTY, S	61	400548		WARF, J PALENIK, G	60	700849
SPK	LA			CRY5	LA C 2		
	GRATTON, L	62	400567		PALENIK, C WARF, J	62	700850
SPK	LA			CRY5	LA C 2		
	MOORE, C	68	601088		BREDIG, M	60	700852
SPK	LA			CRY5	LA C 2		
	YATSMIRSKII, K	48	700761		SPEDDING, F GSCHNE	68	700858
SPK	LA			CRY5	LA C 2		
	BURBRIDGE E BURHR	66	601003		ATOJI M	61	700864
SPK	LA			CRY5	LA C 2		
	RUBESKA, I	62	600119		ATOJI, M MEDRUD, R	69	700867
SPK	LA			CRY5	LA C 2		
	MURAKAWA, K KAMEI	63	601218		ATOJI, M GSCHNEIDE	68	700868
SPK	LA			CTEX	LA C 2		
	SCHWARZSCHILD, M	67	601047		KRIKORIAN, O	60	700847
SPK	LA			REAC	LA C 2		
	MOORE, C	68	700913		KOVALCHENKO, M NES	68	700869
THER	LA			SPK	LA C 2		
	PARKINSON, D H SIM	61	400557		LOWRIE, R	60	701014
VAP	LA			SPK	LA C 2		
	ACKERMANN, R RAUH	62	700840		LOWRIE, R	61	700956
VAP	LA			SPK	LA C 2		
	BEAVIS, L	60	700878		LOWRIE, R	61	700736
VAP	LA			THER	LA C 2		
	ACKERMANN, J RAUH	62	700909		CHUPKA, W BERKOWIT	68	700866
THER	LA +			CRY5	LA C 3		
	GREEN, J POLAND, D	60	700882		ATOJI, M WILLIAMS	60	

CRY5	LA N			MPP	LA20 3		
YOUNG, R ZIEGLER		52	100205	TRESVYATSKIY, S CH		51	300440
CRY5	LA N			MPP	LA20 3		
YOUNG, R ZIEGLER		52	700855	NAGASAWA, S		50	400530
CRY5	LA N			PHAS	LA20 3		
KLEMM, W WINKELMAN		55	700874	SCHNEIDER, S ROTH		50	700747
MPP	LA N			PHAS	LA20 3		
LYUTAYA, M SAMSONO		53	301529	EYRING, L VORRES		50	700748
THER	LA N			PHAS	LA20 3		
KELLEY, K		37	700855	LAMBERTSON, W GUNZ		52	700752
THER	LA N			PHAS	LA20 3		
BAUGHAN, E		59	700876	WOLF, L SCHWAB, H		51	201408
CRY5	LA N SYST			REAC	LA20 3		
IANDELLI, A		37	501275	KELER, E GODINA, N		51	300387
DHD	LA O			REAC	LA20 3		
CHUPKA, W INGRAM		55	700925	MOROZOV, I KORSHUN		58	700753
DHD	LA O			TRT	LA20 3		
GOLDSTEIN, H		51	201215	LAMBERTSON, W GUNZ		52	700752
DHD	LA O			S	LA20 3		
WALSH, P WHITE, D		58	700805	BLOMEKE, J O ZIEGL		51	400552
DHD	LA O			S	LA20 3		
WALSH, P GOLDSTEIN		50	700924	KELLEY, K KING, E		51	700915
F	LA O			THER	LA20 3		
BREWER, L CHANDRAS		59	700892	KING, E WELLER, W		51	300712
H	LA O			THER	LA20 3		
KELLEY, K		50	700891	INGHRAM, M CHUPKA		57	501057
PHAS	LA O			THER	LA20 3		
FOEX, M		51	201153	BLOMEKE, J O ZIEGL		51	400552
S	LA O			THER	LA20 3		
KELLEY, K		50	700891	BREWER, L		53	700905
SPK	LA O			VAP	LA20 3		
AKERLIND, L		52	300510	TOSIM, S		57	501505
SPK	LA O			VAP	LA20 3		
MURTHY, N		51	301057	GOLDSTEIN, H		51	201215
SPK	LA O			VAP	LA20 3		
HATUECLER, S ROSEN		59	700759	WALSH, P WHITE, D		58	700805
SPK	LA O			VAP	LA20 3		
ROSEN, B		51	700890	WALSH, P GOLDSTEIN		50	700888
SPK	LA O			VAP	LA20 3		
AKERLIND, L		52	700894	GOLDSTEIN, H WALSH		51	700889
THER	LA O			VAP	LA20 3		
BREWER, L		53	700921	ACKERMAN, J THORN		51	700905
VAP	LA O			VAP	LA20 3		
GOLDSTEIN, H WALSH		51	700889	GOLDSTEIN, H		50	201018
VAP	LA O			VAP	LA20 3		
GOLDSTEIN, H WALSH		50	700895	WALSH, P GOLDSTEIN		50	700924
VAP	LA O			DH	LA O SYST		
KULVARSHAYA, B MAS		50	301054	WALSH, P N DEVER		51	700542
VAP	LA O			MISC	LA O SYST		
WALSH, P GOLDSTEIN		50	700924	LORIER, J		49	400542
CPH	LA20 3			PHAS	LA SI O SYST		
GOLDSTEIN, H NGILS		59	501195	TOROPOV, N BONDAR		50	201505
CPH	LA20 3			DH	LANTHANIDE IONS		
BLOMEKE, J O ZIEGL		51	400552	YATSIMIRSKII, K B		49	400553
CPL	LA20 3			THER	LANTHANIDE IONS		
JUSTICE, B WESTRUM		53	300905	YATSIMIRSKII, K B		49	400553
CPL	LA20 3			THEO	LANTHANIDES		
GOLDSTEIN, H		58	501551	SCHENK, P		49	400579
CPL	LA20 3			VAP	LANTHANIDES		
GOLDSTEIN, H NEILS		59	700835	ZADUMKIN, S TAMBIE		51	301020
CRY5	LA20 3			ELCH	LATTICE STRUCTURE		
KOEHLER, W WOLLAN		53	700754	BETHE, H		53	301131
CRY5	LA20 3			PHAS	LA U O SYST		
JOHNSON, Q TEMPLET		51	700851	HILL, D		52	201573
CRY5	LA20 3			MPP	LIGHT		
IANDELLI, A		55	700897	PLYLER, E BLAINE		55	500720
DF	LA20 3			DH	L120		
COUGHLIN, J		54	700914	BERKOWITZ, J CHUPK		59	700892
DH	LA20 3			MSP	L120		
HUBER, E HOLLEY, C		53	700900	BERKOWITZ, J CHUPK		59	700892
DH	LA20 3			THER	L120		
COUGHLIN, J		54	700914	BERKOWITZ, J CHUPK		59	700892
DH	LA20 3			VAP	L120		
WARTENBERG, H		59	700923	FIRSOVA, L NESEMEY		50	200751
DHD	LA20 3			MPP	LIQUID METALS		
WALSH, P GOLDSTEIN		50	700924	SAMARIN, A		50	400555
H	LA20 3			CPH	LIQUIDS		
BLOMEKE, J O ZIEGL		51	400552	AFENKOV, N		52	301392

MPP	LIQUIDS		
GROSSE, A		61	301463
THEO	LIQUIDS		
EDWARDS, S		62	301438
THEO	LIQUIDS		
GROSSE, A KIRSHENB		62	301143
THEO	LIQUIDS		
GORDON, R		61	202041
THEO	LIQUIDS		
GROSSE, A		63	202043
THEO	LIQUIDS		
HIRSCHFELDER, J CU		54	202051
THEO	LIQUIDS		
GRIGOROVICH, V		60	301233
THEO	LIQUIDS		
GROSSE, A KIRSHENB		63	301235
THEO	LIQUIDS		
PREDVODITELEV, A		63	301322
CPH	LIQUIDS		
KUDRYAYTSEV, B		62	300363
CPL	LU		
JENNINGS, L MILLER		60	201049
DH	LU		
WHITE, D		61	201217
VAP	LU		
WHITE, D WALSH, P		61	301014
VAP	LU		
WHITE, D WALSH, P		60	301622
PHAS	LU B 2		
PRZYLYLSKA, M REDD		63	300962
CEMP	LU B 6		
SAMSONOV, G PADERN		59	300143
VAP	LU O		
KULVARSHAYA, B MAS		60	301064

M

CRYS	M O		
DUAN, F NAY BEN, M		63	301213
VAP	MASS SPEC		
HILL, H REED, R		63	301243
MPP	MATERIALS		
STEWART, R JOHNSON		61	301598
PHAS	MATERIALS		
LOVEJOY, D		63	202087
REV	MATERIALS		
KORNILOV, I POLYAK		63	202080
REV	MATERIALS		
HAUCK, J		63	202048
REV	MATERIALS		
BARTLETT, E		63	201997
THEO	MELTING		
ARDELL, A		63	301174
THEO	MELTING		
BABB, S		63	301177
THEO	MELTING		
ROTT, L		62	301331
DF	METAL BORIDES		
LANGER, S		61	700939
PHAS	METAL BORIDES		
LANGER, S		61	700939
THEO	METAL BORIDES		
LANGER, S		61	700939
VAP	METAL BORIDES		
LANGER, S		61	700939
DF	METAL CARBIDES		
LANGER, S		61	700939
PHAS	METAL CARBIDES		
LANGER, S		61	700939
THEO	METAL CARBIDES		
LANGER, S		61	700939
VAP	METAL CARBIDES		
LANGER, S		61	700939
SPK	METAL COMPOUND		
KLIMOV, V		61	700670

CEMP	METAL OXIDES		
OREILLY, D		61	700633
DF	METAL OXIDES		
GLEISER, M		61	700616
REV	METAL OXIDES		
GLEISER, M		61	700616
E	METALLIC COMPOUND		
SAMSONOV, G SHULIS		62	300756
BOOK	METALLURGY		
VULF, B ROMADIN		62	301614
BOOK	METALLURGY		
HUME-ROTHERY, W		62	202059
VAP	METALS		
LYUBITOV, YU		59	301295
BETA	METALS		
MITRA, S JOSHI, S		61	700630
CPH	METALS		
LOWENTHAL, G		63	300938
CPH	METALS		
PCHELKIN, I		61	300649
CPL	METALS		
ELIASHBERG, G		62	300881
CPL	METALS		
NITRA, S JOSHI, S		61	700630
CRYS	METALS		
SMALLMAN, R		63	301157
CTEX	METALS		
HANAK, J DAANE, A		61	201378
DHD	METALS		
SHULISHOVA, O		62	301587
DHT	METALS		
MORIN, F MAITA, J		63	301043
E	METALS		
LADD, M-LEE, W		62	300575
MISC	METALS		
MCCULLOUGH, R		62	301751
MPP	METALS		
OSMININ, Y		62	301152
MPP	METALS		
EREMENKO, V NIZHEN		61	300537
MPP	METALS		
TIMOFEEVICHEVA, O		61	300540
MPP	METALS		
MCQUEEN, R MARSH		60	200777
MPP	METALS		
CHAUDRON, G		61	700557
MPP	METALS		
GARBFR, R GINDIN		61	700673
MSP	METALS		
VELISEV, J		63	202152
THEO	METALS		
LIBBY, W		62	202086
REV	METALS		
COOPER, T SRP, O		63	202019
THEO	METALS		
ENIG, J		63	202030
THEO	METALS		
BREWER, L		63	202009
VAP	METALS		
BURTSEV, V SAMARIN		62	202012
PHAS	METALS		
TSAREV, B KUDINTSE		58	301161
PHAS	METALS		
NORTON, J OGILVIE		57	201086
REAC	METALS		
MARKSTEM, H		63	301532
REAC	METALS		
WILSON, B		60	200595
REV	METALS		
SPEDDING, F DAANE		60	200553
REV	METALS		
STADELMAIER, H		61	201365
REV	METALS		
PECKNER, D		62	201944
REV	METALS		
VAN ARKEL, A		62	201957
SURF	METALS		
PUGACHEVICH, P LAZ		60	200576

SURF	METALS			VAP	MG		
STRAUSS, S		60	201065	GOLDSMITH, A HIRSC		60	700930
SURF	METALS			VAP	MG		
MONMA, K		60	201440	HANLIN, H		60	700951
TCON	METALS			VAP	MG		
POWELL, R BLANPIED		54	600906	FRANZEN, J HINTENB		61	700970
TCON	METALS			VAP	MG		
LEBEDEV, V		60	200842	GRJOTHEIM, K HERST		61	200990
TCON	METALS			REAC	MG B		
MENDELSSOHN, K ROS		61	201403	MARKOUSHII, L KAPU		62	201722
TCON	METALS			CRYG	MG B 2		
EWING, C WALKER, B		62	201768	JONES, M MARSH, R		54	300909
theo	METALS			CRYG	MG B 2		
KAUFMAN, L CLOUGHE		63	301495	RUSSELL, V HIRST		53	300968
THEO	METALS			REAC	MG B 6		
HARRISON, W		63	301468	MARKOVSKII, L		62	301530
THEO	METALS			REAC	MG B12		
SAMOILOV, O		61	300539	MARKOVSKII, L		62	301530
THER	METALS			PHAS	MG BORIDES		
ESIN, O SRYVALIN		60	300276	CHRETIEN, A DUHART		62	300536
THER	METALS			PHAS	MG B SYST		
WHITE, J		60	300318	DUHART, P		62	300876
THER	METALS			PHAS	MG B SYST		
EDELEANU, C LITTLE		60	200838	MARKOVSKII, L KOND		55	300942
TRT	METALS			PHAS	MG B SYST		
STRAUSS, S		60	201065	MARKOVSKII, L KOND		55	300943
TRT	METALS			CRYG	MG CE SYST		
GOPAL, R MOHD		62	301461	BELETSKII, M GALPE		61	200827
VAP	METALS, ALKALI			CRYG	MG IR SYST		
SHPIILRAYN, E ASINO		62	301099	FERRO, R RAMBALDI		62	201626
CPH	METALS, LIQUID			VAP	MG N		
SOLTYK, V		62	301158	SMITH, J		62	201743
REV	METALS, LIQUID			KIN	MG3N 2		
FROST, B		62	301451	DERRAS, R PAIBASSI		62	201918
THER	METALS, LIQUID			THER	MG3N 2		
KIM, W		62	301499	SCHICK, H ANTHROP		63	301579
CPH	MG			CRYG	MG ND SYST		
WILLIAMS, N N		61	700659	BELETSKII, M GALPE		61	200827
CPL	MG			CPH	MG O		
COLLINS, M		62	300870	VICTOR, A DOUGLAS		60	700949
CPL	MG			CPH	MG O		
MARTIN, D		61	300666	FIELDHOUSE, I LANG		60	601583
MG				CPL	MG O		
LAWLEY, A		60	200801	VICTOR, A DOUGLAS		60	700949
CRYG	MG			REAC	MG O		
GETTE, E FOOTE, F		35	700610	KOMAREK, K COUCOUL		63	301269
CTEX	MG			REAC	MG O		
BESSERER, C		58	700929	RYABCHIKOV, I MIKU		62	301336
DH	MG			REAC	MG O		
GOLDSMITH, A HIRSC		60	700930	RYABCHIKOV, I MIKU		63	301337
ERES	MG			TRT	MG O		
BRIDGMAN, P		51	400533	SCHNEIDER, S		63	301348
MPP	MG			CPH	MG O		
BESSERER, C		58	700929	VICTOR, A DOUGLAS		63	301372
PHAS	MG			CPL	MG O		
GOLDSMITH, A HIRSC		60	700930	LIEN, W		62	201454
PHAS	MG			CRYG	MG O		
BEREZHOI, A KORDY		62	201553	COCCO, A SCHROMEK		61	201211
REAC	MG			CTEX	MG O		
EVSTYUKHIN, A		59	200852	FIELDHOUSE, I LANG		60	601583
RHO	MG			ERES	MG O		
MCGONIGAL, P KIRSH		62	201532	MITOFF		62	201874
SPK	MG			H	MG O		
CRISP, R WILLIAMS		60	201000	VICTOR, A DOUGLAS		60	700949
SPK	MG			MISC	MG O		
PENKIN, N SHABANOV		62	601601	LADD, M LEE, W		60	201322
SPK	MG			MPP	MG O		
CODLING, K		61	600775	WUENSCH, B VASILOS		62	201835
TCON	MG			MPP	MG O		
BESSERER, C		58	700929	WUENSCH, B VASILOS		61	301018
THER	MG			MPP	MG O		
BARRIAULT, R DREIK		62	300865	GANESAN, S		62	201559
THER	MG			PHAS	MG O		
DEWING, E		60	201204	HINZ, I DIETZEL, A		62	301472
THER	MG			PHAS	MG O		
WILLIAMS, N N		61	700659	MASSAZZA, F		61	201293
VAP	MG			REAC	MG O		
FUJINO, S OKADA, M		62	301452	LEONOV, A		61	301622

REAC	MG O						
TOGURI, J		60	201009				
REAC	MG O						
GRJOTHEIM, K HERST		61	200990				
REAC	MG O						
POLUNINA, G KOVBA		61	201624				
REAC	MG O						
SOLACOLU, S		61	201694				
SPK	MG O						
NICHOLLS, R		62	601625				
SPK	MG O						
NAZIMOVA, N		60	201227				
SPK	MG O						
ORTENBERG, F		61	300821				
SPK	MG O						
PESIC, D		60	701002				
SPK	MG O						
ORTENBERG, F		61	300795				
SPK	MG O						
BREWER, L TRAJMA		62	201780				
SPK	MG O						
BREWER, L TROJMAR		62	300788				
SPK	MG O						
PESIC, D		60	600655				
SPK	MG O						
VEITS, I GURVICH		67	600899				
SPK	MG O						
LAGERQVIST, A UHLE		49	600923				
SPK	MG O						
LAGERQVIST, A UHLE		49	600924				
SPK	MG O						
TRAJMAR, S		61	700962				
SPK	MG O						
NAZIMOVA, N SOKOLO		61	700671				
SPK	MG O						
SOLOKOV, V NEZIMOV		60	201622				
TCON	MG O						
FIELDHOUSE, I LANG		60	601583				
TCON	MG O						
ADAMS, M		64	600961				
THEO	MG O						
TAWDE, N SREEDHARA		62	300782				
THER	MG O						
SCHICK, H ANTHROP		62	300995				
TRT	MG O						
MCNALLY, R PETERS		61	600828				
VAP	MG O						
METSON, G		63	301536				
VAP	MG O						
ALTMAN, R		63	300844				
VAP	MG O						
GILBREATH, J		66	601274				
CPH	MG O						
VICTOR, A DOUGLAS		60	202153				
CEMP	MG OXIDES						
PALGUEV, S NECEIMI		62	201717				
DHD	MG OXIDES						
VEITS, I GURVICH		66	700964				
THER	MG OXIDES						
DEWING, E		60	201204				
THER	MG OXIDES						
VEITS, I GURVICH		66	700964				
CEMP	MISC						
KISER, R		60	200784				
CPH	MISC						
NAGASAKI, S TAKAGI		48	400598				
CPL	MISC						
BARBER, S MARTIN		69	600650				
DH	MISC						
BARANOVSKY, V		62	300366				
DF	MISC						
ANON		60	300226				
ELCH	MISC						
STERN, K			300305				
EMF	MISC						
GERASIMOV, V GROMO		61	300445				
MPP	MISC						
SMIRNOVA, V ORMONT		69	300267				
MPP	MISC						
WICHES, E		62	300369				
MPP	MISC						
KIRILLIN, V VUKALO		61	300378				
MPP	MISC						
GOLDANSKIY, V KAGA		60	400589				
MPP	MISC						
TRETYACHENKO, G KR		61	400610				
MSP	MISC						
JENCKLE, L		61	300322				
MSP	MISC						
BRYUKAHNOV, A GOLU		62	400614				
MSP	MISC						
ALEKSEYEVSKIY, N		68	400600				
PHAS	MISC						
TISZA, L		61	700592				
PMCH	MISC						
EVERHART, J LINDLI		43	600907				
SPK	MISC						
HERTZBERG, G		69	200765				
SPK	MISC						
MAJUMDAR, K VARSHN		64	600886				
SPK	MISC						
MAJUMDAR, K VARSHN		64	600887				
SPK	MISC						
MAJUMDAR, K VARSHN		64	600888				
SPK	MISC						
MAJUMDAR, K VARSHN		64	600889				
SPK	MISC						
VARSHNI, Y MAJUMDA		66	600895				
SPK	MISC						
FERRARO, J R		61	700571				
THEO	MISC						
MASLOV, P MASLOV		61	700538				
THEO	MISC						
KLIUCHNIKOV, N		60	300747				
THEO	MISC						
AFANASYEV, A		61	400603				
THEO	MISC						
BADYLKES, I		61	700593				
THEO	MISC						
KAROPETYANTS, M		61	700617				
THER	MISC						
ANON		60	300226				
THER	MISC						
HECHT, C		62	300365				
THER	MISC						
TISZA, L		61	700592				
VAP	MISC						
KOML, G VETRENKO		68	300421				
ZKP	MISC						
BAIBUZ, V		62	300601				
CRYS	MN						
KRYISYAKEVICH, P		60	600698				
DH	MN						
GOLDSMITH, A HIRSC		60	700930				
ERES	MN						
NOVIKOV, A TYSPIN		69	201632				
PHAS	MN						
TOPCHIASHVILI, L		60	201238				
PHAS	MN						
GOLDSMITH, A HIRSC		60	700930				
SPK	MN						
GOODMAN, NOLDEKE		62	300789				
SPK	MN						
ROSENZWEIG, N PORT		60	700901				
SPK	MN						
ROSENZWEIG, N PORT		60	700996				
SPK	MN						
MURAKAWA, K KAMEI		63	601218				
THEO	MN						
ROSENZWEIG, N PORT		60	700996				
THEO	MN						
ROSENZWEIG, N PORT		60	700901				
THER	MN						
SCHICK, H ANTHROP		62	300995				
THER	MN						
BUTLER, J F MCCABE		61	700629				

VAP	MN			CRYS	MN O 2		
GOLDSMITH, A HIRSC		60	700930	KONDRASHEV, Y		61	700942
VAP	MN			MPP	MN O 2		
HANLIN, H		60	700951	SRB, V		61	201083
VAP	MN			MPP	MN O 2		
BUTLER, J F MCCABE		61	700629	GATTOW, G GLEMSE		61	700876
REAC	MN B			PHAS	MN O 2		
MARKOVSKII, L		62	301530	KONDRASHEV, Y		61	700942
CRYS	MN B 2			PHAS	MN O 2		
ARONSSON, B		60	201380	GATTOW, G GLEMSE		61	700876
CRYS	MN B 2			PHAS	MN O 2		
BINDER, I POST, B		60	200779	FISHBURN, H PILL		61	201360
REAC	MN B 2			PHAS	MN O 2		
MARKOVSKII, L		62	301530	BHIDE, V DAMLE, R		61	201598
MPP	MN B 4			REAC	MN O 2		
FRUCHART, R MICHEL		60	300241	GATTOW, G GLEMSE		61	700576
PHAS	MN B P SYST			TRT	MN O 2		
RUNDQVIST, S		62	300546	GATTOW, G GLEMSE		61	700576
CPL	MN BR2			CRYS	MN3O 4		
STOUT, J		58	201122	SATOMA, K		61	201025
REAC	MN2B			REAC	MN OXIDES		
MARKOVSKII, L		62	301530	ANIKEEV, V LYUBAN		60	201035
REAC	MN3B 4			DHD	MN OXIDES		
MARKOVSKII, L		62	301530	ANIKEEV, V LYUBAN		60	201035
ELCH	MN BORIDES			VAP	MN OXIDES		
ALENARD, S		61	201402	GLEMSE, O WEIZENK		61	201441
CEMP	MN B SYST			THER	MN OXIDES		
CADEVILLE, M MEYER		62	202013	BLUMENTHAL, R WHIT		61	600829
CRYS	MN5C 2			ELCH	MN OXIDES		
SENATEUR, J FRUCHA		62	201957	BLUMENTHAL, R WHIT		61	600829
THER	MN7C 3			ERES	MN O SYST		
GOKCEN, N FUJISHIR		63	301456	BHIDE, V DANI, R		61	201324
THER	MN7C 3			MPP	MN O SYST		
ANON		60	700992	GATTOW, G GLEMSE		61	700577
THER	MN7C 3			PHAS	MN O SYST		
BUTLER, J F MCCABE		61	700629	KLINGSBERG, C RUST		60	700518
THER	MN7C 3			REAC	MN O SYST		
ANON		60	700904	GATTOW, G GLEMSE		61	700577
VAP	MN7C 3			PHAS	MN RE SYST		
ANON		60	700904	SAVITSKII, E TYLKI		61	700625
VAP	MN7C 3			THER	MN SI SYST		
ANON		60	700992	GOLUTVIN, KOZLON		63	301228
VAP	MN7C 3			PHAS	MN SI B SYST		
ANON		60	600866	ARONSSON, B ENGSTR		60	201348
VAP	MN7C 3			PHAS	MN SI O SYST		
BUTLER, J F MCCABE		61	700629	SINGLETON, E CARPE		62	201560
DF	MN23C6			PHAS	MN TA SYST		
ALEXEEV, V SCHWARZ		61	300405	SAVITSKII, E KAPET		60	201701
TCON	MN F 2			PHAS	MN TI SYST		
SLACK, G		61	201125	SAVITSKII, E KOPET		60	201261
DH	MN N SYST			PHAS	MN TI ZR O SYST		
SHCHUKAREV, S MORO		61	700666	WYDER, W HOCH, M		62	300548
PHAS	MN N SYST			DH	MN W O SYST		
LIHL, F ETTMAYER		62	301028	PROSHINA, Z		60	201249
THER	MN N SYST			PHAS	MN ZR SYST		
AGLADZE, R I MANPO		61	700551	SAVITSKII, E KOPET		60	201261
REAC	MN N SYST			BETA	MO		
AGLADZE, R I MANP		61	700551	KRUPNIKOU, K BAKAN		63	301149
CRYS	MN O			BIB	MO		
HOCH, M		63	301477	WENSRICH, C		60	700972
CRYS	MN O			BIB	MO		
BIRCHENALL, C		60	200775	WOHL, M		60	700723
DHD	MN O			BIB	MO		
HULDT, L LAGERQVIS		52	600764	RICHERT, E BECKETT		49	700564
PHAS	MN O			CEMP	MO		

CPH	MO			MPP	MO		
	KIRILLIN, V SHEIND	62	300734		HOUCK, J	61	701003
CPH	MO			MPP	MO		
	RASOR, N MCCLELLAN	60	700896		RASOR, N MCCLELLAN	60	700896
CPH	MO			MPP	MO		
	CHEKHOVSKOI, V	62	300633		KOPETSKIY, CH.	62	301270
CPH	MO			MPP	MO		
	LEHMAN, G	60	300304		MING, N FAN, T LI	63	301304
CPH	MO			MPP	MO		
	KIRILLIN, V SHEIND	61	300332		BESSERER, C	58	700929
CPH	MO			MPP	MO		
	KARAREYA, I.	61	300344		ARGENT, B MILNE, G	60	201039
CPH	MO			MPP	MO		
	KIRILLIN, V SHEIND	61	300425		RICHERT, E BECKETT	49	700564
CPH	MO			MPP	MO		
	KIRILLIN, V SHEIND	62	601564		BADIALI, M KIRSHEN	63	301404
CPH	MO			PHAS	MO		
	TAYLOR, R	61	201250		COFFMAN, J COULSON	61	701040
CPH	MO			PHAS	MO		
	BRONSON, H CHISHOL	33	700561		SHAFFER, P	61	700941
CPH	MO			PHAS	MO		
	LAZAREVA, I. KANTOR	61	700631		BRILLIANTOV, N STA	61	300807
CPL	MO			PHAS	MO		
	FINCH, R	61	700547		BRILLIANTOV, N STA	61	300807
CPL	MO			PHAS	MO		
	CHEKHOVSKOI, V	62	300633		HAWORTH, C	60	201017
CPL	MO			PHAS	MO		
	BORELIUS, G	60	601168		FUNKE, V NOVIKOVA	62	201704
CPL	MO			REAC	MO		
	TAYLOR, R	61	201250		FRANTSEVICH, I LAV	59	200869
CPL	MO			REAC	MO		
	CLARK, C	62	601563		KOMAR, A TALANIN	60	200843
CPL	MO			REAC	MO		
	FEATHERSTON, F NEI	63	301444		DEUTSCH, N ERVIN	60	500123
CPL	MO			REAC	MO		
	BRYANT, C KEESOM	61	600831		KUBASCHEWSKI, O HO	60	201038
CPL	MO			REAC	MO		
	SHARAN, B	61	301070		EREMENKO, V VELIKA	59	201279
CRYS	MO			REAC	MO		
	COFFMAN, J COULSON	61	701040		ENGELKE, J HALDEN	60	201529
CRYS	MO			REAC	MO		
	EDWARDS, J SPEISER	51	601179		VEROT, J FORESTIER	61	201528
CRYS	MO			REAC	MO		
	GETTE, E FOOTE, F	35	700510		ZELIKMAN, A KREIN	62	201861
CRYS	MO			REAC	MO		
	LU, S CHANG, Y	41	700512		ANDREEVA, V ALEKSE	62	201814
CRYS	MO			REV	MO		
	AGGARWAL, P GOSWAM	57	700514		SYRE, R	61	201579
CRYS	MO			REV	MO		
	MATYUSHENKO, N	62	301150		WOHLI, M	60	701053
CTEX	MO			REV	MO		
	RASOR, N MCCLELLAN	60	700984		RICHERT, E BECKETT	49	700564
CTEX	MO			SPK	MO		
	EDWARDS, J SPEISER	51	601179		ALLEN, R GLASIER	60	200828
CTEX	MO			SPK	MO		
	BESSERER, C	58	700929		ROGOSA, G SCHWARZ	53	500124
CTEX	MO			SPK	MO		
	NOWOTNY, H LAUBE	61	600844		SHADMI, Y	61	700954
DH	MO			SPK	MO		
	KIRILLIN, V SHEIND	62	601564		CLAUS, G ULMER, K	63	202017
DF	MO			SPK	MO		
	COFFMAN, J COULSON	61	701040		TREES, R	61	701067
ERES	MO			SPK	MO		
	TAYLOR, R	61	201250		ROSENZWEIG, N PORT	60	700996
ERES	MO			SPK	MO		
	TYE, R	61	201117		SWEENEY, W SEAL, R	61	201112
ERES	MO			SURF	MO		
	RUDKIN, R	60	700898		RUDKIN, R	60	700898
ERES	MO			TCON	MO		
	FINCH, R	61	700547		RUDKIN, R	60	201901
ERES	MO			TCON	MO		
	BRIDGMAN, P	51	400533		BESSERER, C	58	700929
ERES	MO			TCON	MO		
	MARGOTIN, P DURAND	62	201863		RASOR, N MCCLELLAN	60	700896
H	MO			TCON	MO		
	KIRILLIN, V SHEIND	61	300921		RASOR, N MCCLELLAN	60	700984
MISC	MO			TCON	MO		
	HAMPEL, C	61	200889		TYE, R	61	201117

TCON	MO			THER	MO CARBONYLS		
LEBEDEV, V		61	201312	KAWAI, K MURATA, H		60	200806
THEO	MO			REAC	MO CE		
ROSENZWEIG, N PORT		60	700996	GAVMEMAHN, F BLANC		62	201520
THER	MO			SPK	MO CL5		
RASOR, N MCCLELLAN		60	200960	BADER, R		61	201260
VAP	MO			DH	MO F 6		
BABELIOWSKY, T		62	300858	SETTLE, J FEDER, H		61	300740
VAP	MO			SPK	MO F 6		
CANO, G		62	301423	CLAASSEN, H SELIG		62	201854
VAP	MO			PHAS	MO HF SYST		
COFFMAN, J COULSON		61	701040	TAYLOR, A		61	201207
VAP	MO			THER	MO HALIDES		
GLEMSE, O HAESELE		62	201927	SHCHUKAREV, S VASI		61	201459
PHAS	MO AL C			THER	MOLECULES		
JEITSCHKO, W NOWOT		63	301486	SEIGEL, B SEIGEL		63	301361
H	MO B			SPK	MONATOMIC GASES		
MEZAKI, R TILLEUX		62	601617	JUDD, B		62	300804
S	MO B			THER	MONATOMIC GASES		
MEZAKI, R TILLEUX		62	601617	GORDON, J		61	300639
H	MO B 2			THER	MONATOMIC GASES		
MEZAKI, R TILLEUX		62	601617	POLAND, D GREEN, J		62	300758
PHAS	MO B 2			THER	MONATOMIC GASES		
FORELIK, C YELYUTI		62	300864	GURVICH, L KVLIVDZ		61	300457
S	MO B 2			THER	MONATOMIC GASES		
MEZAKI, R TILLEUX		62	601617	GURVICH, I KVLIVID		62	400602
CRYS	MO B 2			S	MONATOMIC IONS		
GORELIK, C ELYUTIN		62	301230	VDOVENKO, U SUGLOB		58	601155
DH	MO B 4			CRYS	MO N		
SHCHUKAREV, S VASI		61	201413	TROITSKAMA, N PINS		63	202147
PHAS	MO B 4			CRYS	MO N		
CHRETIEN, A HELGOR		61	201084	TROITSKAYA, N PINS		59	200858
H	MO2B			MPP	MO N		
MEZAKI, R TILLEUX		62	601617	SAMSONOV, G VERKHO		62	300997
S	MO2B			CEMP	MO NITRIDES		
MEZAKI, R TILLEUX		62	601617	SAMSONOV, G		60	700947
MPP	MO2B 5			DH	MO NITRIDES		
MALYUCHKOV, O POVI		62	202095	SAMSONOV, G		60	700947
EMF	MO BORIDES			REV	MO NITRIDES		
BECK, W		61	300477	SAMSONOV, G		60	700947
REAC	MO B SYST			PHAS	MO N SYST		
SAMSONOV, G STRASH		62	300990	TROITSKAYA, N V PI		61	700601
CEMP	MO C			CRYS	MO O		
INGOLD, J		63	301251	MAGNELI, A		60	600617
CRYS	MO C			MSP	MO O		
CLOUGHERTY, E LOTH		61	600843	DEMAUA, G BURNS, R		60	601163
CRYS	MO C			CRYS	MO O 2		
KOVALSKII, A SEMEN		59	201671	CHANEY, W		61	701068
CRYS	MO C			THER	MO O 2		
KAYE, G		62	201909	RAPP, R		63	301326
PHAS	MO C			DF	MO O 2		
CLOUGHERTY, E LOTH		61	600843	GLEISER, M CHIPMAN		62	301053
PHAS	MO C			DH	MO O 2		
NADLER, M KEMPTER		60	300301	KRESTOVNIKOV, A		62	300930
CPH	MO2C			MSP	MO O 2		
NEEL, D PEARS, C		61	300146	DEMAUA, G BURNS, R		60	601163
CRYS	MO2C			REAC	MO O 2		
FRIES, R KEMPTER		60	701000	KOZMANOV, Y		60	201005
CRYS	MO2C			VAP	MO O 2		
PARTHE, E		62	601630	PLANTE, E R		60	300141
DF	MO2C			CRYS	MO O 3		
GLEISER, M CHIPMAN		62	301053	CHANEY, W		61	701068
PHAS	MO2C			CRYS	MO O 3		
NADLER, M KEMPTER		60	700903	YODA, E		60	600855
THER	MO2C			DF	MO O 3		
SCHICK, H ANTHROP		63	3				

VAP	MO O 3		
HOERBE, R KNACKE		61	300451
VAP	MO O 3		
GULBRANSEN, E		63	300891
VAP	MO O 3		
SPITSYN, V ZIMAKOV		61	301593
REAC	MO30		
KIHLBORG, L		62	202068
PHAS	MO OXIDE		
KIHLBORG, L		59	201174
CPH	MO OXIDES		
KING, E WELLER, W		60	700973
CPL	MO OXIDES		
KING, E WELLER, W		60	700973
CRYS	MO OXIDES		
OZEROV, R		55	701064
DHT	MO OXIDES		
KING, E WELLER, W		60	700973
PHAS	MO OXIDES		
KING, E WELLER, W		60	700973
S	MO OXIDES		
KING, E WELLER, W		60	700973
THER	MO OXIDES		
KING, E WELLER, W		60	700973
PHAS	MO O SYST		
RODE, E LYSANOVA		62	201843
CRYS	MO O SYST		
KIHLBORG, L		63	301498
KIN	MO O SYST		
GULBRANSEN, E		63	301465
PHAS	MO O SYST		
ANON		60	701015
VAP	MO O SYST		
ANON		60	701015
REAC	MO O C SYST		
HEGEDUS, A NEUGEBR		60	200789
PHAS	MO OS		
TAYLOR, A DOYLE, N		62	301026
PHAS	MO RE SYST		
FENG, C LEVESQUE		61	300530
PHAS	MO RH SYST		
ANDERSON, E HUME R		60	200969
PHAS	MO RU SYST		
ANDERSON, E HUME R		60	201071
ERES	MO SI2		
NESHPOR, V SAMSONO		62	301037
THER	MO SI2		
BOLGAR, A		61	700938
VAP	MO SI2		
BOLGAR, A		61	700938
ERES	MO3SI		
NESHPOR, V SAMSONO		62	301037
ERES	MO5SI3		
NESHPOR, V SAMSONO		62	301037
VAP	MO SI SYST		
HASAPIS, A MELVEGE		61	701039
PHAS	MO TI ZR SYST		
HOCH, M DESJARDIN		62	300899
PHAS	MO V SYST		
KORNILOV, I POLYAK		61	201242
PHAS	MO V C SYST		
RUDY, E RUDY, E		62	900222
DHT	MO X2		
SHUKUROV, T NIKOLS		61	201907
DHT	MO X3		
SHUKUROV, T NIKOLS		61	201907
PHAS	MO ZR C SYST		
WALLACE, T GUTTIERR		63	301375

N

CEMP	N		
SAMSONOV, G NESHPO		59	201052
SPK	N		
BAER, P MIESCHER		52	600729

SPK	N		
PILCHER, G SKINNER		62	301044
THER	N		
GERSH, S		47	900215
CPH	N 2		
WILLIAMS, N N		61	700659
DH	N 2		
GLOEKLER		61	300636
DHD	N 2		
LOFTHUS, A		60	600568
DHD	N 2		
BROOK, M KAPLAN, J		54	600571
DHD	N 2		
CARIO, G REINECKE,		50	600573
DHD	N 2		
DOUGLAS, A HERZBER		61	600577
DHD	N 2		
FARBER, M DARNELL		53	600579
DHD	N 2		
HENDRIE, J		55	600582
DHD	N 2		
LINDHOLM, E		54	600590
DHD	N 2		
TOENNIES, J GREENE		57	600600
H	N 2		
BOND, W		60	600664
PHAS	N 2		
PANNETIER, G MARSI		61	600850
SPK	N 2		
PANNETIER, G MARSI		61	600850
SPK	N 2		
CARROLL, P		63	301424
SPK	N 2		
CARROLL, B SAYERS		53	600545
SPK	N 2		
WOLFSBERG, M		53	600546
SPK	N 2		
BRYAH, R HOLT, R		57	600549
SPK	N 2		
NICHOLLS, R REEVES		59	600562
SPK	N 2		
WATANABE, K MARMO		56	600567
SPK	N 2		
LOFTHUS, A		60	600568
SPK	N 2		
ASTOIN, N GRANIER		57	600569
SPK	N 2		
BRANSCOMB, L		51	600570
SPK	N 2		
CARROLL, P RUBALCA		59	600572
SPK	N 2		
CARIO, G REINECKE		50	600573
SPK	N 2		
CARROLL, B		58	600574
DHD	N 2		
CHRISTIAN, R DUFF		55	600575
SPK	N 2		
CARROLL, B ROBALEA		60	600693
SPK	N 2		
BAER, F MIESCHER		52	600729
SPK	N 2		
DOUGLAS, A		52	600576
SPK	N 2		
DRESSLER, K		59	600578
SPK	N 2		
FEAST, M		51	600580
SPK	N 2		
GRIIN, A		55	600581
SPK	N 2		
HENDRIE, J		55	600582
SPK	N 2		
HEPNER, G HERMAN		57	600583
SPK	N 2		
HERMAN, L HERMAN		52	600584
SPK	N 2		
HERMAN, R WENIGER		52	600585
SPK	N 2		
HERMAN, R		52	600586

SPK N 2			SPK N O		
JANIN, J	50	600587	MIGEOTTE, P ROSEN	45	600752
SPK N 2			SPK N O		
KISTIAKOWSKY, G WA	58	600588	MIGEOTTE, P ROSEN	50	600753
SPK N 2			SPK N O		
LEBLANC, F TANAKA	58	600589	MIGEOTTE, P	45	600751
SPK N 2			SPK N O		
LOFTHUS, A	56	600591	NICHOLLS, R	62	601625
SPK N 2			SPK N O		
LOFTHUS, A	57	600592	MIESCHER, E	56	600750
SPK N 2			SPK N O		
LOFTHUS, A MULLIKE	57	600593	MIESCHER, E	55	600749
SPK N 2			SPK N O		
MUSCHLITZ, E GOODM	53	600594	MARYOTT, A KRYDER	59	600748
SPK N 2			SPK N O		
OGAWA, M TANAKA, Y	59	600595	MARMO, F	53	600747
SPK N 2			SPK N O		
OGAWA, M TANAKA, Y	60	600596	LAGERQVIST, A MIES	58	600746
SPK N 2			SPK N O		
SAYERS, D CARROLL	53	600597	HERZBERG, G LAGERQ	56	600744
SPK N 2			SPK N O		
STOICHEFF, B	54	600598	GALLAGHER, J KING	55	600743
SPK N 2			SPK N O		
TANAKA, Y	55	600599	GALLAGHER, J JOHNS	56	600742
SPK N 2			SPK N O		
VANDERSLICE, J MAS	59	600601	GALLAGHER, J BEDAR	54	600741
SPK N 2			SPK N O		
WILKINSON, P	57	600602	FEAST, M	50	600740
SPK N 2			SPK N O		
WILKINSON, P MULLI	57	600603	DEEZSI, I MATRIN	57	600739
SPK N 2			SPK N O		
WILKINSON, P	60	600604	DEEZSI, I	58	600738
SPK N 2			SPK N O		
WILKINSON, P	59	600605	DEEZSI, I	56	600737
SPK N 2			SPK N O		
WORLEY, R	53	600606	BURRUS, C GRAYBEAL	58	600736
SPK N 2			SPK N O		
DIELSE, G HEATH, D	60	600618	BURRUS, C GORDY, W	53	600735
THER N 2			SPK N O		
WILLIAMS, N N	61	700659	BERINGER, R RAUSON	54	600734
SPK N 2			SPK N O		
BAER, P MIESCHER	53	600730	BARROW, R MIESCHER	57	600733
THER N H 3			SPK N O		
PHILLIPS, J WHITE	52	600892	SUTCLIFFE, L WALSH	53	600732
DH N O			THER N O		
KOERNER, W DANIELS	52	600745	BIGELEISEN, J	60	600799
DHD N O			VAP N O		
BROOK, M KAPLAN, J	54	600671	BIGELEISEN, J	60	600799
SPK N O			SPK N O		
BAER, P MIESCHER	52	600729	BAER, P MIESCHER	53	600730
SPK N O			SPK N 20		
BAER, P MIESCHER	53	600730	PALIK, E RAO, K	56	600717
SPK N O			SPK N 20		
BAER, P MIESCHER	51	600728	RANK, D EASTMAN, D	61	600835
SPK N O			SPK N 20		
PALIK, E RAO, K	56	600717	TIDWELL, E	60	600821
SPK N O			CPH N 20 4		
TANAKA, Y	54	600683	HISATSUME, J	59	600807
SPK N O			S N 20 4		
FLETCHER, W BEGUN	57	600763	HISATSUME, J	59	600807
SPK N O			SPK N 20 4		
UEDA, M	55	600762	JACAB, J	59	600808
SPK N O			SPK N 20 4		
THOMPSON, H GREEN	56	600761	HISATSUME, J	59	600807
SPK N O			ZKP N 20 4		
TANAKA, Y SEYA, M	51	600760	JACOB, J	59	600808
SPK N O			BIB NITRIDES		
SHAW, J	56	600759	EHL, R	59	201141
SPK N O			CEMP NITRIDES		
OGAWA, M	53	600758	KUBASCHENSKI, O	56	601642
SPK N O			CEMP NITRIDES		
OGAWA, M	55	600757	GOODMAN, P HOMONOF	61	301460
SPK N O			CEMP NITRIDES		
TANAKA, Y	54	600756	SCLAR, N	61	300682
SPK N O			MISC NITRIDES		
OGAWA, M	55	600755	STRASHINSKAYA, L	62	201790
SPK N O			MPP NITRIDES		
NICHOLS, N HAUSE	55	600754	POPOVA, O KABANNIK	62	300960

PHAS	NITRIDES			ERES	NB		
PORTNOY, K		60	700944	BERLINCOURT, T		59	601655
REAC	NITRIDES			SPK	NB		
SAMSONOV, G VERKHO		59	201280	CLAUS, H ULMER, K		63	202017
REV	NITRIDES			REAC	NB		
REPENKO, K		62	301329	KOFSTAD, P		62	202074
REV	NITRIDES			ERES	NB		
EICK, H		61	301439	TYE, R		61	201117
REV	NITRIDES			H	NB		
EHL, R		59	201141	GELD, P KUSENKO, F		60	600803
SURF	NITRIDES			KIN	NB		
ZADUMKIN, S		61	201849	ARZHANYI, P VOLKOV		62	201975
TCON	NITRIDES			KIN	NB		
LVOV, S		61	300937	ARZHANYI, R VOLKOV		61	201401
THER	NITRIDES			MISC	NB		
OLIVER, R BAIER, R		63	301314	HAMPEL, C		61	200889
THER	NITRIDES			MISC	NB		
LIUTAIA, M BUKHANE		62	202088	WADSLEY, A		61	201100
THER	NITRIDES			MPP	NB		
KUBASCHENSKI, O		58	601642	ZAKHAROVA, G POPOV		61	301021
REAC	N TH SYST			MPP	NB		
GERDS, A MALLETT		54	600985	HARRIS, W		61	201239
REAC	N U SYST			MPP	NB		
MALLETT, M GERDS		55	600986	ZAKHAROVA, G MISHI		59	301022
CEMP	NA C			MPP	NB		
BONDARENKO, B ERMA		62	301409	RICKERT, E BECKETT		49	601638
BOOK	NB			MPP	NB		
SAMSONOV, G KONSTA		61	301570	RILEY, W MCCLELLAN		62	301080
CPH	NB			MPP	NB		
JOHNSON, R		60	301488	ARGENT, B MILNE, G		60	201039
CRYS	NB			PHAS	NB		
BOONE, D WERT, C		63	301410	STORMS, E KRIKORIA		60	700980
MPP	NB			PHAS	NB		
FRERICHS, R		62	301450	SHAFFER, P		61	700941
MPP	NB			PHAS	NB		
EVSTYUKHIN, A NIKI		62	301442	HAWORTH, C		60	201017
PHAS	NB			PHAS	NB		
BABITZKE, H ASAI		62	201988	SAVITSKII, E BARON		58	201345
BIB	NB			PHAS	NB		
ANON		60	701022	WYDER, W HOCH, M		62	201581
BIB	NB			PMCH	NB		
WENSRICH, C		60	700972	BOLEF, D		61	200936
BIB	NB			PREP	NB		
WOHL, M		60	700723	MILLER, G		62	201943
CEMP	NB			REAC	NB		
RICKERT, E BECKETT		49	601638	MILLER, G		60	200834
MPP	NB			REAC	NB		
KOPETSKIY, CH		62	301270	FAIRBROTHER, F COW		59	200886
THER	NB			REAC	NB		
KRAFTMAKHER, YA		63	301279	ONG, J FASSELL, W		62	601683
CPH	NB			REAC	NB		
CARTER, W		61	601638	DEUTSCH, N ERVIN		60	600123
CPH	NB			REAC	NB		
GELD, P KUSENKO, F		60	600803	KOFSTAD, D KJOLLES		60	201952
CPL	NB			REAC	NB		
CLUSIUS, K FRANZOS		60	700987	KOFSTAD, P KJOLLES		61	201010
CPL	NB			REAC	NB		
DAUNT, J OLSEN, J		61	701027	KUBASCHESKI, O HO		60	201038
CPL	NB			REAC	NB		
BOORSE, H HIRSHFEL		60	600651	SCHAFER, H SIBBING		60	201085
CPL	NB			REAC	NB		
BORELIUS, G		60	601168	ARKHAROV, V GERASI		61	300549
CPL	NB			REAC	NB		
HIRSHFELD, A LEUPO		62	201933	ESTUIN, G BUROVA		61	300552
CRYS	NB			REAC	NB		
STORMS, E KRIKORIA		60	700980	HURLEN, T		61	700542
CRYS	NB			REAC	NB		
EDWARDS, J SPEISER		51	601179	ENGELKE, J HALDEN		60	201529
CTEX	NB			REAC	NB		
CARTER, W		61	601631	KORNILOV, I POLYAK		62	201681
CTEX	NB			REAC	NB		
EDWARDS, J SPEISER		51	601179	BLACKBURN, P		62	201961
OH	NB			REAC	NB		
MOROZOVA, M STOLYA		60	300186	KONSTANTINOV, V		62	301148
ELCH	NB			REAC	NB		
MONNIER, R GRANDJE		60	200949	AMOSOV, V		62	301125
ERES	NB			REAC	NB		
BRIDGMAN, P		51	400533	RROKOSHKIN, D VASI		62	201974

REV	NB			CPH	NB C		
BARTLETT, E SCHMID		61	701052	GELD, P KUSENKO, F		60	600803
REV	NB			CRYS	NB C		
WOHLL, M		60	701053	STORMS, E KRIKORIA		60	700980
REV	NB			CRYS	NB C		
HARRIS, W		61	201239	STORMS, E KRIKORIA		60	700979
REV	NB			VAP	NB C		
DOUGLAS, D KUNZ, F		61	300419	FESENKO, V BOLGAR		63	301216
REV	NB			DH	NB C		
PECKNER, D		61	201307	MAH, A HOYLE, B		55	301297
REV	NB			REAC	NB C		
SYRE, R		61	201579	SAEKI, Y OMORI, G		63	301339
S	NB			CRYS	NB C		
CLUSIUS, K FRANZOS		60	700987	KEMPTER, C STORMS		60	701008
SPK	NB			CRYS	NB C		
KORSUNSKII, M GENK		60	201274	ELLIOT, R KOMJATH		60	600621
SPK	NB			CRYS	NB C		
HOLLIDAY, J		61	201225	KEMPTER, C STORMS		63	201053
SPK	NB			CRYS	NB C		
SHADMI, Y		61	700954	STORMS, E KRIKORIA		60	600845
SPK	NB			DH	NB C		
ROSENZWEIG, N PORT		60	700996	KORNILOV, A LEONID		62	300923
SPK	NB			DHD	NB C		
SWEENEY, W SEAL, R		61	201112	BITTNER, H GORETZK		62	301132
SPK	NB			H	NB C		
KORSUNSKIY, M GENK		60	400616	GELD, P KUSENKO, F		60	600803
SURF	NB			CEMP	NB C		
COST, J		62	201781	BITTNER, H GORETZK		62	202004
TCON	NB			MPP	NB C		
CONNOLY, A MENDELS		62	201535	GIORGI, A SZKLARZ		63	202039
TCON	NB			KIN	NB C		
TYE, R		61	201117	KIRILLOVA, G MEERS		60	200759
THEO	NB			PHAS	NB C		
ROSENZWEIG, N PORT		60	700996	NADLER, M KEMPTER		60	700903
THEO	NB			PHAS	NB C		
FRANK, R		60	201284	STORMS, E KRIKORIA		60	700980
THER	NB			PHAS	NB C		
SCHICK, H ANTHROP		63	300994	SHAFFER, P		61	700941
THER	NB			PHAS	NB C		
CARTER, W		61	601631	NORTON, J		60	701001
THER	NB			PHAS	NB C		
CARTER, W		62	300749	BENESOVSKY, E RUDY		61	100181
VAP	NB			PHAS	NB C		
BEAVIS, L		60	600659	NADLER, M KEMPTER		60	300301
PHAS	NB AL C			REAC	NB C		
JEITSCHKO, W NOWOT		63	301485	SAMSONOV, G			301571
PHAS	NB ALLOYS			S	NB C		
RICHER, H WINCIERZ		62	201766	KAUFMAN, L		62	300910
THER	NB B			SPK	NB C		
MEERSON, G		60	300298	KORSUNSKII, M GENK		60	201274
H	NB B 2			THER	NB C		
MEZAKI, R TILLEUX		62	601617	SCHICK, H ANTHROP		63	301579
MPP	NB B 2			THER	NB C		
MALYUCHKOV, O POVI		62	202096	BOLGAR, A		61	700938
S	NB B 2			TRT	NB C		
MEZAKI, R TILLEUX		62	601617	MATTHIAS, B		61	300945
SPK	NB B 2			VAP	NB C		
KORSUNSKII, M GENK		60	201274	FRIES, R		62	601478
THER	NB B 2			CEMP	NB C		
SCHICK, H ANTHROP		63	301580	SAMSONOV, G FOMENK		63	202128
CRYS	NB3B 2			VAP	NB C		
KIEFFER, B BENESOV		58	600619	BOLGAR, A		61	700938
PHAS	NB B SYST			CRYS	NB2C		
NOWOTNY, H BENESOV		59	201339	ELLIOT, R KOMJATH		60	600621
REAC	NB B SYST			THER	NB2C		
SAMSONOV, G STRASH		62	300990	SCHICK, H ANTHROP		63	301579
PHAS	NB B SI ALLOYS			DH	NB CARBIDES		
NOWOTNY, H BENESOV		60	201765	HUBER, E		61	201192
DH	NB BR5			DH	NB CARBIDES		
GROSS, P HAYMAN, C		62	300706	KUSENKO, F GELD, P		60	701007
DH	NB BR5			REAC	NB CARBIDES		
SHCHUKAREV, S SIMI		62	201748	MEERSON, G ZELIKMA		61	201912
DH	NB BR O SYST			SURF	NB CARBIDES		
SHCHUKAREV, S SIMI		62	201748	FOMENKO, V		61	201420
CEMP	NB C			PHAS	NB C SYST		
BONDARENKO, B ERMA		62	301409	ELLIOTT, R		62	301441
CPH	NB C			THER	NB C SYST		
KUSENKO, F GELD, P		59	300929	CUNNINGHAM, G WARD		63	301208

PHAS	NB C SYST			CEMP	NB NITRIDES		
ELLIOTT, R		61	300262	SAMSONOV, G		60	700947
PHAS	NB C SYST			DH	NB NITRIDES		
ELLIOT, R KOMJATHY		60	301066	SAMSONOV, G		60	700947
PHAS	NB C SYST			REV	NB NITRIDES		
GELD, P LIUBIMOV		61	300380	SAMSONOV, G		60	700947
PHAS	NB C SYST			CTEX	NB N SYST		
KIMURA, H SASAKI		61	601678	SAMSONOV, G VERKHO		61	601576
PHAS	NB C SYST			PHAS	NB N SYST		
KOVALCHENKO, M SAM		61	201472	BRAUER, G ESSELBOR		61	700575
REAC	NB C SYST			VAP	NB N SYST		
SAMSONOV, G STRASH		62	300990	COST, J WERT, C		62	300681
REAC	NB C SYST			PHAS	NB N SYST		
PORTNOI, K LEVINSK		61	300216	ELLIOT, R KOMJATHY		60	301066
VAP	NB C SYST			PHAS	NB N SYST		
FRIES, R		62	300691	ELLIOTT, R KOMJATH		60	600621
REAC	NB C O SYST			ERES	NB N SYST		
STEVENS, E WILHELM		61	301697	SAMSONOV, G VERKHO		61	601576
REAC	NB C O SYST			VAP	NB N SYST		
SHVEIKIN, G GELD		63	301367	COST, J WERT, C		63	301432
KIN	NB C O SYST			VAP	NB N SYST		
SHVEIKIN, G		58	301366	SAMSONOV, G VERKHO		61	601576
PHAS	NB C FE SYST			CRYS	NB N 2 SYST		
BELIKOV, A SAVINSK		62	300863	ELLIOTT, R KOMJATH		61	701063
REAC	NB C W SYST			PHAS	NB N 2 SYST		
EVSTYUKHIN, A NIKI		62	300883	ELLIOTT, R KOMJATH		61	701063
THER	NB CL			CRYS	NB O		
SCHAFER, H KAHLENB		60	200820	BRAUER, G MORAWIET		62	301106
DF	NB CL5			CRYS	NB O		
JERE, G PATEL, C		60	200860	HOCH, M		63	301477
DH	NB CL5			CRYS	NB O		
SHCHUKAREV, S ORAN		60	200944	BRAUER, G MORAWIET		62	301414
SPK	NB CL5			CRYS	NB O		
BADER, R		61	201260	NORIN, R MAGNELI		60	200781
PHAS	NB CL O SYST			DF	NB O		
MEYER, G OOSTEROM		61	201213	HOCH, M		60	300311
PHAS	NB H SYST			EMF	NB O		
ELLIOTT, R KOMJATH		60	600621	LAVRENTEV, V GERAS		61	701030
MISC	NB MO SYST			REAC	NB O		
BRAUN, H SEDLATSCH		60	200806	LAVRENTEV, V GERAS		61	701030
ERES	NB MO SYST			REAC	NB O		
HULM, J BLAUGHER		61	201421	HICKS, W		61	201011
PHAS	NB MO C SYST			REAC	NB O		
RUDY, E BENESOVSKY		61	300449	SAZHIN, N KOLCHIN		61	300381
PHAS	NB MO V			REAC	NB O		
BARON, V IVANOVA		60	200918	GORDON, G SCHEVERM		60	201499
PHAS	NB MO W			REAC	NB O		
SAVITSKII, E BARON		62	201705	KOLSKI, T		62	201497
CEMP	NB N			REAC	NB O		
SAMSONOV, G FOMENK		63	202128	GURIEV, T		61	201792
CRYS	NB N			CPH	NB O		
KORSUNSKII, M GENK		63	301274	KUSENKO, F GELD, P		59	300929
MPP	NB N			CRYS	NB O		
SAMSONOV, G VERKHO		61	301673	BAAUER, G MORAWIET		62	601681
THER	NB N			MSP	NB O		
BOLGAR, A		61	700938	SHCHUKAREV, S SEME		62	301354
VAP	NB N			SPK	NB O		
SAMSONOV, G VERKHO		61	301669	UHLER, U		55	301370
VAP	NB N			S	NB O		
BOLGAR, A		61	700938	KAUFMAN, L		62	300910
S	NB N			SPK	NB O		
KAUFMAN, L		62	300910	UHLER, U		54	600915
CEMP	NB N			SPK	NB O		
KORSUNSKII, M GENK		62	300912	GRAVLEN, W SALOMON		60	200911
TRT	NB N			THER	NB O		
MATTHIAS, B		61	300945	HOCH, M		61	301475
MPP	NB N			THER	NB O		
SAMSONOV, G VERKHO		62	300997	SCHICK, H ANTHROP		63	301580
CRYS	NB2N			THER	NB O		
ELLIOT, R KOMJATH		60	600621	LAVRENTEV, V GERAS		61	701030
CRYS	NB4N 3			THER	NB O		
ELLIOT, R KOMJATH		60	600621	PEMSLER, J P		61	700650
PHAS	NB NITRIDES			TRT	NB O		
BRAUER, G		61	201142	KOLCHIN, O SUMAROK		61	600873
SPK	NB NITRIDES			TRT	NB O		
KORSUNSKII, M GENK		60	201274	ELLIOT, R KOMJATH		60	600621
PHAS	NB NITRIDES			TRT	NB O		
BRAUER, G		60	201037	ELLIOT, R		60	600625

VAP	NB O				
LAVRENTEV, V GERAS		61	701030		
CPH	NB O 2				
KUSENKO, F GELD, P		62	300727		
CPH	NB O 2				
KUSENKO, F GELD, P		59	300929		
CPH	NB O 2				
GELD, P KUSENKO, F		60	600803		
CRYS	NB O 2				
MARINDER, B O		61	700649		
DH	NB O 2				
KUSENKO, F GELD, P		62	300727		
DH	NB O 2				
MOROZOVA, M STOLYA		60	300186		
EMF	NB O 2				
LAVRENTEV, V GERAS		61	701030		
H	NB O 2				
GELD, P KUSENKO, F		60	600803		
H	NB O 2				
KING, E CHRISTENSE		61	600826		
REAC	NB O 2				
KUSENKO, F GELD, P		60	200823		
REAC	NB O 2				
LAVRENTEV, V GERAS		61	701030		
S	NB O 2				
KING, E CHRISTENSE		61	600826		
THER	NB O 2				
LAVRENTEV, V GERAS		61	701030		
TRT	NB O 2				
KOLCHIN, O SUMAROK		61	600873		
TRT	NB O 2				
ELLIOT, R KOMJATH		60	600621		
TRT	NB O 2				
ELLIOT, R		60	600625		
VAP	NB O 2				
LAVRENTEV, V GERAS		61	701030		
VAP	NB O 2				
GOLUBTSOV, I LAPIT		60	701029		
VAP	NB O 2				
SHCHUKAREV, S SEME		62	300744		
THER	NB O 2				
SCHICK, H ANTHROP		63	301580		
SPK	NB O 5				
CONLON, D DOYLE, W		61	201325		
PHAS	NB20				
BRAUER, G MUELLER		58	301197		
KIN	NB20 3				
SHVEIKIN, G GELD		60	200762		
PHAS	NB20 5				
DIAMOND, J SCHNEID		60	202028		
ERES	NB20 5				
MANALOV, P ESIN, O		62	202096		
CRYS	NB20 5				
NORIN, R		63	202110		
REAC	NB20 5				
GELD, P LYUBIMOV		62	301223		
ERES	NB20 5				
GREENER, E FEAR, G		63	301232		
CEMP	NB20 5				
JANNINCK, R WHITMO		63	301254		
ERES	NB20 5				
JANNINCK, R		63	301255		
REAC	NB20 5				
KIMURA, H SASAKI		62	301262		
ERES	NB20 5				
KOFSTAD, P		62	301267		
PHAS	NB20 5				
KOFSTAD, P		61	301268		
ZKP	NB20 5				
LYUBINOV, V GELD		61	301294		
ERES	NB20 5				
MAKKAY, R FINE, M		62	301298		
ERES	NB20 5				
REISMAN, A HOLTZBE		59	301328		
PHAS	NB20 5				
ZVINCHUK, R		58	301385		
CEMP	NB20 5				
GRUNER, E WHITMORE		61	700527		
CPH	NB20 5				
GELD, P KUSENKO, F		60	600803		
CPH	NB20 5				
KUSENKO, F GELD, P		59	300929		
CPH	NB20 5				
KUSENKO, F GELD, P		62	300727		
CRYS	NB20 5				
KOFSTAD, P KJOLLES		61	701034		
CRYS	NB20 5				
MARINDER, B		62	601678		
CRYS	NB20 5				
LAKHIANI, D SHREIR		60	700978		
DH	NB20 5				
KORNILOV, A LEONID		62	601591		
DH	NB20 5				
KUSENKO, F GELD, P		62	300727		
DH	NB20 5				
MOROZOVA, M P STOL		60	300186		
DH	NB20 5				
KUSENKO, F G GELD		60	300252		
EMF	NB20 5				
LAVRENTEV, V GERAS		61	701030		
ERES	NB20 5				
GREENER, E WHITMOR		60	600631		
ERES	NB20 5				
GRUNER, E WHITMORE		61	700527		
H	NB20 5				
GELD, P KUSENKO, F		60	600803		
KIN	NB20 5				
MOROZOV, I STEFANY		58	200796		
KIN	NB20 5				
GELD, P SHVEIKIN		60	200996		
PHAS	NB20 5				
GOLDSCHMIDT, H		60	200765		
PHAS	NB20 5				
ROTH, R WARING, J		61	201408		
REAC	NB20 5				
SHVEIKIN, G P		58	300151		
REAC	NB20 5				
LAVRENTEV, V GERAS		61	701030		
REAC	NB20 5				
LINBIMOV, V GELD		61	300388		
THER	NB20 5				
KORNILOV, A LEONID		62	601591		
THER	NB20 5				
SCHICK, H ANTHROP		63	301580		
THER	NB20 5				
LAVRENTEV, V GERAS		61	701030		
VAP	NB20 5				
LAVRENTEV, V GERAS		61	701030		
VAP	NB20 5				
GOLUBTSOV, I LAPIT		60	701029		
DH	NB OXIDES				
KUSENKO, F GELD, P		60	701007		
REAC	NB OXIDE				
BRAUER, G MULLER			300561		
THER	NB OXIDES				
ORTNER, N ANDERSON		59	701066		
VAP	NB OXIDES				
ORTNER, N ANDERSON		59	701066		
KIN	NB O SYST				
HURLEN, T KJOELLES		59	201306		
MPP	NB O SYST				
ALYAMOVSKIY, G SHV		58	400597		
PHAS	NB O SYST				
KUSENKO, F GELD, P		61	201116		
MPP	NB O SYST				
GEBHARDT, E ROTHEN		63	202035		
KIN	NB O SYST				
HURLEN, T		60	301250		
VAP	NB O SYST				
SHCHUKAREV, S SEME		59	301353		
PHAS	NB O SYST				
SHVEIKIN, G GELD		58	301356		
PHAS	NB O SYST				
BRAUER, G MUELLER		63	301196		
PHAS	NB O SYST				
BRAUER, G MUELLER		62	301413		

PHAS	NB O SYST			CRYB	ND		
ELLIOTT, R		62	301441	ELLINGER, F		53	601253
PHAS	NB O SYST			CRYB	ND		
BRAUER, G MUELLER		62	301413	ELLINGER, F		55	600977
PHAS	NB O SYST			DH	ND		
TERAO, N		63	301603	JOHNSON, R		56	601293
PHAS	NB O SYST			DH	ND		
KOUBA, L TRUNOV, V		62	301278	WHITE, D		61	201217
PHAS	NB O SYST			CTEX	ND		
GRIGOREVA, N SELEZ		62	300888	ANDRES, K		63	301172
PHAS	NB O SYST			DH	ND		
ELLIOT, R		60	600625	JOHNSON, R HUDSON		62	601224
PHAS	NB O SYST			DH	ND		
ELLIOT, R KOMJATHY		60	301055	AMES LABORATORY		62	601247
PHAS	NB O SYST			DH	ND		
NORMAN, N		62	300374	HUBER, J		52	100213
PHAS	NB O SYST			ERES	ND		
BRAUER, G ESSELBOR		61	201114	ALSTAD, J COLVIN		61	201099
PHAS	NB O SYST			ERES	ND		
ELLE, M CHIPMAN, J		61	300281	SPEEDING, F DAANE		57	601066
PHAS	NB O SYST			ERES	ND		
NORMAN, N KOFSTAD		62	300527	BRIDGMAN, P		51	400533
REAC	NB O SYST			ERES	ND		
ARGENT, B PHELPS		60	600611	GOODMAN, B		52	100208
THER	NB O SYST			ERES	ND		
MEERSON, G		62	300946	JAMES, N LEGNOLD		52	100206
ZKP	NB O SYST			H	ND		
KUSENKO, F GELD, P		61	201116	SPEEDING, F MILLER		51	601241
REAC	NB O C SYST			MPP	ND		
SHVEYKIN, G		58	600672	IOWOV, W MITTSEV		60	601332
THER	NB O C SYST			MSP	ND		
SHVEYKIN, G		58	600671	JOHNSON, R HUDSON		56	601040
ZKP	NB O C SYST			MSP	ND		
KUSENKO, F GELD, P		61	700619	JOHNSON, R HUDSON		52	601224
ZKP	NB O C SYST			PHAS	ND		
SHVEYKIN, G		58	600671	SPEEDING, F DAANE		57	601066
KIN	N O H SYST			PHAS	ND		
BLACKBURN, P		62	301189	JOHNSON, R HUDSON		56	601040
ZKP	NB O H SYST			PHAS	ND		
LINBIMOV, V GELD		61	300388	SPEEDING, F DAANE		57	700872
PHAS	NB O N SYST			PHAS	ND		
ELLIOTT, R KOMJATH		60	600621	JOHNSON, R		56	601293
PHAS	NB PD SYST			PHAS	ND		
SAVITSKII, E BARON		61	201429	TROMBE, F FOEY, M		51	400546
PHAS	NB RE SYST			SPK	ND		
KAUFMANN A R RAPPR		61	300218	NOLDEKE, G		55	601028
PHAS	NB RE SYST			SPK	ND		
GIESSEN, W NORDHEI		61	201233	BURBRIDGE, E BURBR		55	601003
PHAS	NB SI			SPK	ND		
ALYAMOUSKII, P GEL		61	201586	KOROLEV, F		56	601321
PHAS	NB SI O SYST			SPK	ND		
IBRAHIM, M BRIGHT		62	201638	MURAKAWA, K		54	601284
REAC	NB TA			SPK	ND		
SCHAEFER, H HUEESK		62	201959	SCHWARZSCHILD, M		57	601047
PHAS	NB TE SYST			SPK	ND		
GRIGORYAN, I SIMAN		60	200992	SMITH, K SPALDING		62	300777
KIN	NB TI SYST			SPK	ND		
VOITOVICH, R		61	201287	HOVIS, W		62	300824
PHAS	NB TI TA SYST			SPK	ND		
KORNILOV, M PYLAEV		61	300508	GARSTANG, R		52	100207
PHAS	NB TI ZR SYST			SPK	ND		
MIKHEEV, V BELOUSO		61	300834	VAN DIJKE BEATTY, S		51	400548
PHAS	NB U C SYST			SPK	ND		
BENESOVSKY, F RUDY		61	301406	TAKEHIKO, I SHIN Y		50	400552
MISC	NB W SYST			SPK	ND		
BRAUN, H SEDLATSCH		60	200806	GRATTON, I		52	400567
KIN	NB ZR SYST			SPK	ND		
VOITOVICH, R		61	201287	BLAISE, J		58	601123
PHAS	NB ZR SYST			SPK	ND		
LUNDIN, C		61	201120	IONOV, N MITKEV, M		60	601180
CPH	ND			THER	ND		
ARAJA, S COLVIN, R		62	300751	PARKINSON, D H SIM		51	400557
CPH	ND			THER	ND		
SPEEDING, F MILLER		51	601241	SPEEDING, F H MCKE		60	700570
CPL	ND			TRT	ND		
GOODMAN, B		52	100208	JOHNSON, R HUDSON		56	601040
CPL	ND			TRT	ND		
PARKINSON, D H SIM		51	400557	TROMBE, F FOEX, M		51	400546

VAP	ND		
YAMAMOTO, A S LUND		61	300230
VAP	ND		
JOHNSON, R		56	601293
VAP	ND		
WHITE, D WALSH, P		61	301014
VAP	ND		
JOHNSON, R HUDSON		52	601224
VAP	ND		
WHITE, D WALSH, P		60	301622
VAP	ND		
AMES LABORATORY		52	601247
VAP	ND		
WHITE, D WALSH, P		61	300455
SPK	ND+		
JUDD, B		55	600927
SPK	ND+		
NOLDEKE, G STEUDEL		54	600931
SPK	ND1		
NOLDEKE, G STEUDEL		54	600952
SPK	ND2		
BURBRIDGE, G BURBR		54	600937
CEMP	ND B 6		
SAMSONOV, G PADERN		59	300143
CRYS	ND B 6		
SAMSONOV, G PADERN		60	601382
PHAS	ND C SYST		
WARF, J PALENIK, G		60	600636
PHAS	ND CE MG SYST		
ROKHLIN, L		62	201703
VAP	ND CL3		
NOVIKOV, G BAEV, A		62	300686
CRYS	ND N SYST		
IANDELLI, A		38	601276
CRYS	ND O		
ELLINGER, F		53	601253
VAP	ND O		
TROMBE, F FOEX, M		63	301367
DHD	ND O		
GOLDSTEIN, H WALSH		58	201098
DHD	ND O		
GOLDSTEIN, H		61	201216
VAP	ND O		
KULVARSHAYA, B MAS		60	301084
VAP	ND O		
GOLDSTEIN, H WALSH		61	700889
CPH	ND20 3		
PANKRATZ, L KING		62	300958
CPH	ND20 3		
GOLDSTEIN, H NGILS		59	601198
CPH	ND20 3		
BLOMEKE, J O ZIEGL		51	400562
CPL	ND20 3		
GOLDSTEIN, H		58	601551
CPL	ND20 3		
GOLDSTEIN, H NEILSO		60	700836
CPL	ND20 3		
JUSTICE, B WESTRUM		63	300906
CRYS	ND20 3		
DOUGLASS, R		58	601010
H	ND20 3		
BLOMEKE, J O ZIEGL		51	400562
MSP	ND20 3		
PANISH, M		61	601372
REAC	ND20 3		
KELER, E GODINA, N		61	300367
S	ND20 3		
BLOMEKE, J O ZIEGL		51	400562
THER	ND20 3		
BLOMEKE, J O ZIEGL		51	400562
VAP	ND20 3		
GOLDSTEIN, H WALSH		60	700889
VAP	ND20 3		
GOLDSTEIN, H WALSH		58	201098
VAP	ND20 3		
PANISH, M		61	601372
VAP	ND20 3		
GOLDSTEIN, H		57	601489

VAP	ND20 3		
GOLDSTEIN, H		60	201018
VAP	ND20 3		
GOLDSTEIN, H		61	201216
DH	ND O SYST		
WALSH, P N DEVER		61	700642
PHAS	ND O SYST		
POPOV, A GLOCKER		49	400524
PHAS	NI MO CR SYST		
ZAKHAROVA, M PROKO		61	201241
MPP	NONSTOICHIOMETRY		
LAZARUS, D		62	301518
REV	NONSTOICHIOMETRY		
SEEGER, A		61	301588
REV	NONSTOICHIOMETRY		
ANDERSON, J		63	301396
THEO	NONSTOICHIOMETRY		
WADSLEY, A		63	301615
ZKP	NONSTOICHIOMETRY		
ELLIOTT, G LEMONS		63	301440
SPK	NUCLEI		
BELYAEV, S		61	700550

O

PHAS	O		
BEREZHNOL, A KORDY		62	201553
PHAS	O		
WYDER, W HOCH, M		62	201581
SPK	O		
MALTSEV, A KATAEV		60	600701
SPK	O		
PILCHER, G SKINNER		62	301044
THER	O		
ACKERMANN, R THORN		58	601208
MISC	O		
LADD, M LEE, W		60	201322
MPP	O		
REVVAKIN, A		61	201286
CPH	O 2		
WILLIAMS, N N		61	700859
DHD	O 2		
BRIX, B HERZBERG		53	600544
DHD	O 2		
LOSEV, S GENERALOV		61	300583
DHD	O 2		
BRIX, B HERZBERG		54	600548
DHD	O 2		
CAMAC, M VAUGHAN		59	600613
REV	O 2		
HERZBERG, G		52	600536
SPK	O 2		
HERZBERG, G		52	600536
SPK	O 2		
HERZBERG, G		53	600537
SPK	O 2		
MOFFITT, W		51	600539
SPK	O 2		
WEBER, A MCGINNIS		60	600540
SPK	O 2		
BARTH, C KAPLAN, J		59	600541
SPK	O 2		
CHAMBERLAIN, J		58	600542
SPK	O 2		
WILKINSON, B MULLI		57	600543
SPK	O 2		
BRIX, P HERZBERG		53	600544
SPK	O 2		
BROIDA, H GAYDON		54	600547
SPK	O 2		
BRIX, B HERZBERG		54	600548
SPK	O 2		
BRYAH, R HOLT, R		57	600549
SPK	O 2		
BURKHALTER, J ANDE		50	600550

SPK	O 2			SPK	OS		
BURKHALTER, J ANDE		50	600551	MOORE, C		58	601088
SPK	O 2			SPK	OS		
CARROLL, P		59	600552	VAN KLEEF, T KLINK		61	201113
SPK	O 2			SPK	OS		
FEAST, M		49	600553	BLAISE, J		58	601123
SPK	O 2			THEO	OS		
FEAST, M		50	600554	ROSENZWEIG, N PORT		60	700996
SPK	O 2			THEO	OS		
HERMAN, R HERMAN		49	600555	ROSENZWEIG, N PORT		60	700901
SPK	O 2			THER	OS		
HERMAN, R WENIGER		50	600556	BARRIAULT, R DREIK		62	300885
SPK	O 2			TRT	OS		
HERMAN, R HERMAN		50	600557	KNAPTON, A SAVILL		60	201088
SPK	O 2			TRT	OS		
HERMAN, R WENIGER		50	600558	KNAPTON, A SAVILL		60	600663
SPK	O 2			TRT	OS		
MILLER, S TOWNES		53	600559	MCCALDIN, J DUWEZ		54	600956
SPK	O 2			VAP	OS		
MILLER, S TOWNES		53	600560	HASAPIS, A PANISH		60	700994
SPK	O 2			VAP	OS		
MILLER, S TOWNES		53	600561	PANISH, M REIF, L		62	300721
SPK	O 2			REAC	OS BR3		
NICHOLLS, R REEVES		59	600562	SHCHUKAREV, S KOLB		61	201231
SPK	O 2			CRYS	OS B SYST		
TANAKA, Y		52	600563	KEMPTER, C P FRIES		61	700621
SPK	O 2			CRYS	OS B SYST		
TANAKA, Y JURSA, A		56	600564	KEMPTER, C P FRIES		61	700621
SPK	O 2			CRYS	OS B SYST		
WATANABE, K INN, E		53	600566	KEMPTER, C FRIES		61	701050
SPK	O 2			CRYS	OS B SYST		
WATANABE, K MARMO		56	600567	ARONSON, B STENBER		62	300757
SPK	O 2			CRYS	OS B SYST		
CAMAC, M VAUGHAN		59	600613	KEMPTER, C FRIES		61	201103
SPK	O 2			MPP	OS B SYST		
ZIMMERER, R MIZUSH		61	600920	BUDDERY, J WELCH		51	600940
SPK	O 2			PHAS	OS B SYST		
LOSEV, S GENERALOV		61	301113	ROOF, R KEMPTER, C		62	300966
THER	O 2			CRYS	OS C		
WILLIAMS, N N		61	700659	KEMPTER, C NADLER		60	701010
MPP	ORGANICS			PHAS	OS C		
DREISBACH, R		61	300263	NADLER, M KEMPTER		60	300301
BIB	OS			REAC	OS C		
ANON		60	701024	KEMPTER, C NADLER		60	201024
COPT	OS			REAC	OS C		
DOUGLAS, R W ADKIN		61	700614	KEMPTER, C NADLER		60	201024
MPP	OS			CEMP	OS F 6		
FRANCIS, A		62	301076	EISENSTEIN, J		61	201126
CRYS	OS			SPK	OS F 6		
MCCALDIN, J DUWEZ		54	600956	EISENSTEIN, J		61	201126
PHAS	OS			REAC	OS I		
KNAPTON, A SAVILL		60	600663	FERGUSON, J ROBIN		62	201686
PHAS	OS			SPK	OS O		
SAVITSKII, E TYLKI		63	301576	WOODWARD, L CREIGH		60	200760
PHAS	OS			THER	OS O		
KNAPTON, A SAVILL		60	700996	BARRIAULT, R DREIK		62	300865
PHAS	OS			THER	OS O 2		
DOUGLAS, R W ADKIN		61	700614	BARRIAULT, R DREIK		62	300865
REAC	OS			THER	OS O 3		
SPACU, P GHEORGHIV		61	201693	BARRIAULT, R DREIK		62	300865
REAC	OS			THER	OS O 4		
SEMENOV, I KOLBIN		62	201486	BARRIAULT, R DREIK		62	300865
SPK	OS			PHAS	OS RE		
BARINSKI, R NADZHA		60	200910	TYLKINA, M POLYAKO		62	201728
SPK	OS			PHAS	OS RU		
ROSENZWEIG, N PORT		60	700901	TYLKINA, M POLYAKO		62	201729
SPK	OS			PHAS	OS TA SYST		
VAN KLEEF, T		61	600656	KAUFMANN, A R RAPPR		61	300218
SPK	OS			PHAS	OS W SYST		
MURAKAWA, K SUWA		52	600942	KAUFMANN, A R RAPPR		61	300218
SPK	OS			THEO	OXIDATION		
ROSENZWEIG, N PORT		60	700996	LEVINSON, M KOVROV		60	301100
SPK	OS			THEO	OXIDATION		
VANKLEEF, T KLINK		61	701033	SEYBOLT, A		63	301350
SPK	OS			CEMP	OXIDES		
HINES, A ROSS, J		62	601592	KUBASCHENSKI, O		56	601642
SPK	OS			DHD	OXIDES		
VAN KLEEF, T		60	600692	BERKOWITZ, J		59	301187

REAC	OXIDES			TRT	OXIDES		
VAP	COLLONGUES, R GILL	63	301205		SCHNEIDER, S	63	202131
	NOGA, K	62	301313				
CEMP	OXIDES						
	VORONOV, N DANILIN	62	301120				
CRYS	OXIDES						
	BAUR	61	200955				
CRYS	OXIDES			THEO	PARTIAL MOLAR		
	SIDOROV, T	60	201055		KRESTOV, G	63	301283
CRYS	OXIDES			THER	PB		
	WADSLEY, A	61	201101		MARGRAVE, J	61	700967
CTEX	OXIDES			VAP	PB O		
	TAYLOR, R	60	200793		FIRSOVA, L NESEMEY	60	200761
CTEX	OXIDES			CPL	PD		
	KUMAR, S	60	700655		CRANGLE, J SMITH	62	300869
DH	OXIDES			CPL	PD		
	KAPUSTINSKII, A	48	600627		BORELIUS, G	60	601168
DH	OXIDES			dh	PD		
	KLYUCHNIKOV, N	60	300659		GOLDSMITH, A HIRSC	60	700930
DH	OXIDES			DHT	PD		
	SHARUPIN, B VASILK	61	700665		LOWRIE, R	61	700943
DHD	OXIDES			MPP	PD		
	BREWER, L ROSENBLA	61	201111		EREMENKO, V NAIDIC	61	300529
E	OXIDES			MPP	PD		
	MEN, A ORLOV, A	58	200794		FRANCIS, A	62	301076
KIN	OXIDES			PHAS	PD		
	OATS, TODD, D	62	201903		GOLDSMITH, A HIRSC	60	700930
MSP	OXIDES			PHAS	PD		
	GRIMLEY, R BURNS	60	200817		MENDENHALL, C INGE	07	900143
PHAS	OXIDES			SPK	PD		
	SIDEBOTTOM, B WHIT	61	201048		SHADMI, Y	61	700954
PHAS	OXIDES			SPK	PD		
	ESTULIN, G EGORSHI	62	900207		KESSLER, K MEGGERS	64	600976
PHAS	OXIDES			TRT	PD		
	GOUTER, E W	59	700608		MENDENHALL, C INGE	07	900143
PHAS	OXIDES			VAP	PD		
	SCHNEIDER, S ROTH	61	201407		DREGER, L MARGRAVE	60	200922
PHAS	OXIDES			VAP	PD		
	COCCO, A SCHROMEK	61	201637		GOLDSMITH, A HIRSC	60	700930
REAC	OXIDES			VAP	PD		
	MORIN, F	61	201273		DREGER, L	61	300528
REAC	OOXIDES			VAP	PD		
	SAMSONOV, G YASINK	61	100180		WALKER, R F EFIMEN	61	700579
REAC	OXIDES			CRYS	PD B SYST		
	BORCHARDT, H THOMP	60	200887		ARONSON, B ASELIUS	59	601166
REAC	OXIDES			THEO	PHASE DIAGRAM		
	SAMSONOV, G IASINS	61	300340		BREWER, L	63	202009
REAC	OXIDES			THEO	PHASE DIAGRAM		
	TRIBALAT, S JUNGFL	60	200829		HUME, W ROTHERY	63	301249
REV	OXIDES			THEO	PHASE RULE		
	BURKE, J	61	601403		BRYNESTAD, J	63	301199
REV	OXIDES			THEO	PHASES		
	LANE, Z TUNIS, M	62	201940		HERIC, E	63	202049
SPK	OXIDES			THEO	PHASES		
	SIDOROV, T	60	201055		MERTSLIN, R NIKURA	63	202102
SPK	OXIDES			THEO	PHASES		
	VRATNY, F DILLING	61	201385		PAK, T KOGAN, V	62	202113
TCON	OXIDES			THEO	PHASES		
	TAYLOR, R	60	200793		PINAEV, G	63	202118
THEO	OXIDES			THER	PHASES		
	YATSIMIRSKII, K B	61	300180		STORONKIN, A MORAC	63	202144
THER	OXIDES			THER	PHASES		
	ACKERMANN, R J THO	61	700580		STORONKIN, A SMIRN	62	202145
THER	OXIDES			MPP	POLYATOMIC GAS		
	HAHN, W	60	200812		GREEN, M	62	300636
THER	OXIDES			SPK	POLYATOMIC GAS		
	KUBASCHENSKI, O	56	601642		HOUGEN, J	62	300781
THER	OXIDES			THEO	POLYATOMIC GAS		
	BREWER, L	62	300855		KHACKKURUZOV, G MI	61	700547
THER	OXIDES			THEO	POLYATOMIC GAS		
	BREWER, L	63	700843		KHACHKURUZOV, G MI	61	700677
VAP	OXIDES			THER	POLYATOMIC GAS		
	VORONOV, N DANILIN	62	300563		GODNEV, I	66	300532
VAP	OXIDES			THER	POLYATOMIC GAS		
	ACKERMANN, R J THO	61	700580		ARTYM, R	62	300773
VAP	OXIDES			THER	POLYATOMIC GAS		
	BURKE, J	61	601403		MCBRIDE, B GORDON	61	300473

NAME	GRADE	SSN	NAME	GRADE	SSN
THOMAS, POLYATOMIC GAS			CRYSTAL, PR N SYST		
KHACHKURUZOV, G MI	61	700677	IANDELLI, A	37	601276
CPL PR			ERES, PR N SYST		
GOODMAN, B	52	100208	DAOU, J	60	600615
CPL PR			THER, PROPELLANTS		
PARKINSON, D H SIM	51	400557	SUNDARAM, S	63	301365
DH PR			PHAS, PR O		
JOHNSON, R	56	601293	EYRING, L HOLWBERG	62	601590
DH PR			VAP, PR O		
WHITE, D	61	201217	KULVARSHAYA, B MAS	60	301064
DH PR			CRYSTAL, PR O 2		
JOHNSON, R HUDSON	52	601224	GRUEN, D KOEHLER	51	400545
DHT PR			ERES, PR O 2		
CAVALLERO, U	43	700895	KEVANE, C	62	601467
ERES PR			PHAS, PR O 2		
SPEDDING, F DAANE	57	601066	FAETH, P	61	701076
ERES PR			CRYSTAL, PR2O 3		
BRIDGMAN, P	51	400533	HONIG, J	58	601531
ERES PR			CRYSTAL, PR2O 3		
JAMES, N LEGNOLD	52	100206	GRUEN, D KOEHLER	51	400545
ERES PR			MSP, PR2O 3		
ALSTAD, J COLVIN	61	201099	PANISH, M	61	601372
ERES PR			PHAS, PR2O 3		
GOODMAN, B	52	100208	HONIG, J	58	601531
MPP PR			ERES, PR2O 3		
IOWOV, W MITTSEV	60	601332	HONIG, J	58	601531
MSP PR			REV, PR2O 3		
JOHNSON, R HUDSON	52	601224	HONIG, J	58	601531
MSP PR			VAP, PR2O 3		
JOHNSON, R HUDSON	56	601040	PANISH, M	61	601372
PHAS PR			CPH, PR6O 11		
JOHNSON, R	56	601293	BLOMMEKE, J O ZIEGL	51	400562
PHAS PR			H, PR6O 11		
SPEDDING, F DAANE	57	601066	BLOMEKE, J O ZIEGL	51	400562
PR			S, PR6O 11		
JOHNSON, R HUDSON	56	601040	BLOMEKE, J O ZIEGL	51	400562
PHAS PR			THER, PR6O 11		
SPEDDING, F DAANE	57	700872	BLOMEKE, J O ZIEGL	51	400562
SPK PR			BIB, PR OXIDES		
GARSTANG, R	52	100207	JONES, P	60	200984
SPK PR			CRYSTAL, PR O SYST		
HOVIS, W	62	300824	EYRING, L BAENZIGE	62	300825
SPK PR			DH, PR O SYST		
GRATTON, L	52	400567	WALSH, P N DEVER	61	700642
SPK PR			THER, PR O SYST		
BURBRIDGE, E BURBR	55	601003	KUZNETSOV, F REZUK	62	300627
SPK PR			BIB, PT		
IONOV, N MITKEY, M	60	601180	WOHL, M	60	700723
THER PR			BIB, PT		
PARKINSON, D H SIM	51	400557	GOODWIN, T	56	601547
TRT PR			CEMP, PT		
JOHNSON, R HUDSON	56	601040	WHITE, C WOODS, S	57	601050
VAP PR			CEMP, PT		
YAMAMOTO, A S LUND	61	300230	CLUSIUS, K LOSA, C	57	601101
VAP PR			CPH, PT		
JOHNSON, R	56	601293	CARTER, W	61	601631
VAP PR			CPH, PT		
WHITE, D WALSH, P	60	301622	KENDALL, W ORR, R	62	601674
VAP PR			CPH, PT		
WHITE, D WALSH, P	61	300455	DOUGLASS, R HOLDEN	59	700375
VAP PR			CPL, PT		
WHITE, D WALSH, P	61	301014	RAMANATHAN, K SRIN	59	601132
VAP PR			CPL, PT		
JOHNSON, R HUDSON	52	601224	BORELI, S, G	60	601168
SPK PR			CRYSTAL, PT		
JUDD, B	55	600927	EDWARDS, J SPEISER	51	601179
SPK PR2			CTEX, PT		
BURBRIDGE, G BURBR	54	6009			

H	PT		
KENDALL, W ORR, R		62	601874
H	PT		
RAMANATHAN, K SIRI		60	600697
KIN	PT		
FRYBURG, G C PETRU		61	700596
MPP	PT		
FRANCIS, A		62	301076
PHAS	PT		
ORIANI, R JONES, T		54	600954
PHAS	PT		
GOLDSMITH, A HIRSC		60	700930
PHAS	PT		
HENNING, F WENSEL		33	900128
PHAS	PT		
ROESER, W CALDWELL		31	900135
PHAS	PT		
ROESER, W WENSEL		35	900134
PHAS	PT		
WENSEL, H ROESER		34	900133
PHAS	PT		
DAY, A SOSMAN, R		10	900137
PHAS	PT		
MENDENHALL, C INGE		07	900143
PHAS	PT		
JAFFEE, R MAYKUTH		60	201285
REAC	PT		
LACROIX, R		56	601037
REAC	PT		
FRYBURG, G C PETRU		61	700596
REAC	PT		
BARTLETT, N LOHMAN		60	201810
REV	PT		
CHASTON, J		50	600941
REV	PT		
KLAUS, K		54	600973
SPK	PT		
MOORE, C		58	601088
SPK	PT		
KESSLER, K MEGGERS		54	600976
SURF	PT		
KOZAKEVITCH, P URB		61	201558
TC ON	PT		
KRISHMAN, K		54	601281
REV	PT		
BETTERIDGE, W RHYS		62	202003
TC ON	PT		
GERTSRIKEN, S		62	301454
TC ON	PT		
WHITE, G WOODS, S		57	601050
THER	PT		
SCHICK, H ANTHROP		62	300995
THER	PT		
CARTER, W		61	601631
THER	PT		
GOODWIN, T		56	601547
THER	PT		
CARTER, W		62	300749
THER	PT		
DOUGLASS, R HOLDEN		59	700375
TRT	PT		
HENNING, F WENSEL		33	900128
TRT	PT		
ROESER, W CALDWELL		31	900135
TRT	PT		
ROESER, W WENSEL		35	900134
TRT	PT		
WENSEL, H ROESER		34	900133
TRT	PT		
DAY, A SOSMAN, R		10	900137
TRT	PT		
MENDENHALL, C INGE		07	900143
VAP	PT		
DREGER, L MARGRAVE		60	200922
VAP	PT		
HANLIN, H		60	700951
VAP	PT		
GOLDSMITH, A HIRSC		60	700930

VAP	PT		
DREGER, L		62	300720
VAP	PT		
DREGER, L		61	300528
VAP	PT		
DREGER, L MARGRAVE		60	600644
VAP	PT		
HAMPSON, R WALKER		61	700681
MPP	PT BORIDES		
POLKOVNIKOV, B BAL		62	300984
CRYS	PT BORIDES		
ARONSSON, B STENBE		60	201349
CRYS	PT B SYST		
ARONSON, B ASELIUS		59	601166
PHAS	PT B SYST		
HUBHARD, F		59	601213
CRYS	PT C SYST		
KONIG, H		51	600944
THER	PT O		
SCHICK, H ANTHROP		62	300995
CRYS	PT O 2		
GOCHE, O		51	600943
CRYS	PT O 2		
SHISHAKOV, N		57	601121
THER	PT O 2		
ALCOCK, C HOOPER		60	601161
DH	PT30 4		
ARIYA, S MOROZOVA		53	600970
THER	PT OXIDES		
SHEWCHUCK, S		52	601252
CRYS	PT O SYST		
BUSCH, R		50	600939
REV	PT O SYST		
BUSCH, R		51	600945
THER	PT O SYST		
SCHAFER, H TEBBEN		60	601159
DH	PU AL SYST		
AKHACHINSKIY, V KO		62	301104
VAP	PU C		
ANSELIN, F PASCARD		62	301126
DH	PU FE SYST		
AKHACHINSKIY, V KO		62	301104
VAP	PU N		
ANSELIN, F PASCARD		62	301126
PHAS	PU O U SYST		
PLIONOWSKI, D DELU		60 TM	600767
VAP	PULSE METHOD		
PROTOPOPOV, N KULG		61	300718

R

VAP	RADIATION		
ZIMAKOV, I SPITSYN		61	300684
REV	RARE EARTHS		
SPEDDING, F		62	301077
CEMP	RARE EARTHS		
SDAR, N		61	300233
CPL	RARE EARTHS		
DREYFUS, B GOODMAN		61	300646
CRYS	RARE EARTHS		
KOMKOV, A		59	201418
DH	RARE EARTHS		
SEREBRENNIKOV, V		57	601131
MPP	RARE EARTHS		
EFREMOV, N		54	600932
PHAS	RARE EARTHS		
SAVITSKII, E LIVAN		61	201889
PREP	RARE EARTHS		
LOVE, B		61	201690
REAC	RARE EARTHS		
VEKSHINA, N MARKOV		61	201423
REAC	RARE EARTHS		
CAMPBELL, T BLOCK		61	201328
REAC	RARE EARTHS		
PICON, M DOMANGE		60	200790

REAC	RARE EARTHS			ERES	R.E. BORIDES		
	TEREKHOVA, V SAVIT	60	200833		KLEBER, E	60	601450
REAC	RARE EARTHS			MISC	R.E. BORIDES		
	WARSHAW, I ROY, R	62	201808		PADERNO, Y FOMENKO	60	200933
REV	RARE EARTHS			MISC	R.E. BORIDES		
	WYLIE, A	50	400550		SAMSONOV, G PADERN	61	300317
REV	RARE EARTHS			MPP	R.E. BORIDES		
	QUILL, L L	50	400553		SAMSONOV, G	58	601255
SPK	RARE EARTHS			MPP	R.E. BORIDES		
	BERGVALL, P HAGSTR	60	601341		NACHMAN, J LUNDIN	62	301539
SPK	RARE EARTHS			MPP	R.E. BORIDES		
	MOORE, C	63	301538		GAUME MAHN, F	58	601048
THR	RARE EARTHS			PHAS	R.E. BORIDES		
	BERG, J	62	201562		KLEBER, E	60	601450
SPK	RARE EARTHS			REAC	R.E. BORIDES		
	BIDELMAN, W	53	100193		KUDINSTEVA, G EPLB	55	601182
SPK	RARE EARTHS			REAC	R.E. BORIDES		
	CONNICK, R	49	400528		KLEBER, E	60	601450
SPK	RARE EARTHS			REV	R.E. BORIDES		
	TCHENG, MAO LIN	49	400584		KLEBER, E	60	601450
SPK	RARE EARTHS			REV	R.E. BORIDES		
	TCHENG, MAO LIN	50	400585		GAUME MAHN, F	58	601048
SPK	RARE EARTHS			BIB	R.E. CARBIDES		
	KNISELEY, R FASSEL	59	601191		KLEBER, E	60	601450
SPK	RARE EARTHS			BIB	R.E. CARBIDES		
	HEORD, J F	50	400586		ANON	58	601561
SPK	RARE EARTHS			DH	R.E. CARBIDES		
	SAKELLARDIS, P	55	600926		WENDLANDT, W GEORG	61	201275
SPK	RARE EARTHS			CPH	R.E. CARBIDES		
	JORGENSEN, C	55	600928		ANON	57	601501
SPK	RARE EARTHS			CRYS	R.E. CARBIDES		
	BURBRIDGE, G BURR	55	600929		ANON	57	601501
SPK	RARE EARTHS			CRYS	R.E. CARBIDES		
	SAKELLARIDIS, P	55	600979		VICKERY, R	58	601532
BOOK	RARE EARTHS			CRYS	R.E. CARBIDES		
	SAVITSKII, E TEREK	62	202129		KLEBER, E	60	601450
SPK	RARE EARTHS			CRYS	R.E. CARBIDES		
	BOVEY, L STEERS, E	59	601190		PALENIK, G	60	200914
SPK	RARE EARTHS			CRYS	R.E. CARBIDES		
	ROSE, A BLANDIN, J	60	201807		SAMSONOV, G ZHURAV	60	600788
THR	RARE EARTHS			DF	R.E. CARBIDES		
	EMLEY, E	52	100209		MCCABE, C L	60	700599
THR	RARE EARTHS			ERES	R.E. CARBIDES		
	BERG, J	62	300390		KLEBER, E	60	601450
THR	RARE EARTHS			MPP	R.E. CARBIDES		
	BAEV, A NOVIKOV, G	61	201410		GAUME MAHN, F	58	601048
VAP	RARE EARTHS			MPP	R.E. CARBIDES		
	WHITE, D	60	300307		SAMSONOV, G ZHURAV	60	600788
VAP	RARE EARTHS			PHAS	R.E. CARBIDES		
	BEAVIS, L	60	701016		KLEBER, E	60	601450
VAP	RARE EARTHS			REAC	R.E. CARBIDES		
	TROMBE, F	53	600960		KLEBER, E	60	601450
ERES	RARE EARTHS			REV	R.E. CARBIDES		
	VERESHCHAGIN, L	61	201570		KLEBER, E	60	601450
REV	RARE METALS			REV	R.E. CARBIDES		
	HAMPEL, C	54	600951		GAUME MAHN, F	58	601048
BIB	R.E. BORIDES			SPK	R.E. ELEMENTS		
	KLEBER, E	60	601450		DIEKE, G CROSSWHIT	61	601406
CRYS	R.E. BORIDES			SPK	R.E. ELEMENTS		
	KLEBER, E	60	601450		ELYASHEVICH, M	53	601413
CRYS	R.E. BORIDES			SPK	R.E. IONS		
	ZHDANOV, G ZHURALE	60	200835		JUDD, B	56	601027
REAC	R.E. BORIDES			CRYS	R.E. IONS		
	PADERNO, Y B SAMS	60	300134		JUDD, B	56	601027
REV	R.E. BORIDES			BIB	R.E. METALS		
	PADERNO, Y B SAMSO	60	300134		KLEBER, E	60	601450
CRYS	R.E. BORIDES			BIB	R.E. METALS		
	NESHPOR, V SAMSONO	57	601107		SACHS, F	61	201059
CRYS	R.E. BORIDES			CEMP	R.E. METALS		
	NESHPOR, V SAMSONO	58	601116		HSIPEH-LIN, S	61	200972
CRYS	R.E. BORIDES			CPH	R.E. METALS		
	LAFFERTY, J	51	400549		MCKEOWN, J	58	601080
CRYS	R.E. BORIDES			CRYS	R.E. METALS		
	EICK, H GILLES, P	59	601184		KLEBER, E	60	601450
CRYS	R.E. BORIDES			CRYS	R.E. METALS		
	EICK, H	58	601537		LADD, M LEE, W	61	601470
ERES	R.E. BORIDES			CRYS	R.E. METALS		
	SAMSONOV, V	61	700587		SAVITSKII, E TEREK	59	201067

CRY5	R.E. METALS	53	600674	ERES	R.E. OXIDES	60	601450
BANISTER, J	LEGVOL			KLEBER, E			
CTEX	R.E. METALS	57	601318	ERES	R.E. OXIDES	59	601152
BARSON, F				NODDACK, I	WALCH, H		
CTEX	R.E. METALS	57	601052	MISC	R.E. OXIDES	60	600875
BARSON, F	LEGVOLD			WESTRUM, E			
CTEX	R.E. METALS	58	601098	MSP	R.E. OXIDES	61	601409
CHANDRASEKHAR, B				PANISH, M			
CTEX	R.E. METALS	56	601499	PHAS	R.E. OXIDES	61	201212
BARSON, F				COLLONGUES, R			
CTEX	R.E. METALS	61	201087	PHAS	R.E. OXIDES	61	601449
SPEEDING, F	HANAK			WESTBROOK, J	CARTE		
CTEX	R.E. METALS	53	601006	PHAS	R.E. OXIDES	60	200937
BARSON, F	LEGVOLD			BONDAR, I			
DM	R.E. METALS	59	601146	PHAS	R.E. OXIDES	60	601450
SPEEDING, F	EBERTS			KLEBER, E			
ERES	R.E. METALS	60	601450	PHAS	R.E. OXIDES	54	600978
KLEBER, E				BRAUER, G	GRADINGE		
MPP	R.E. METALS	59	201067	REAC	R.E. OXIDES	60	601450
SAVITSKII, E	TEREK			KLEBER, E			
PHAS	R.E. METALS	61	601470	REV	R.E. OXIDES	60	601450
LADD, M	LEE, W			KLEBER, E			
PHAS	R.E. METALS	60	601450	THER	R.E. OXIDES	61	601421
KLEBER, E				JUSTICE, B			
REAC	R.E. METALS	60	601450	THER	R.E. OXIDES	62	601612
KLEBER, E				WHITE, D	WALSH, P		
REV	R.E. METALS	61	201205	THER	R.E. OXIDES	62	601454
SAVITSKII, E				WESTRUM, E	JUSTICE		
REV	R.E. METALS	60	601450	THER	R.E. OXIDES	60	601377
KLEBER, E				WHITE, D			
REV	R.E. METALS	63	301401	THER	R.E. OXIDES	60	600675
AVGUSTINIK, A				WESTRUM, E			
REV	R.E. METALS	61	201059	THER	R.E. OXIDES	52	601244
SACHS, F				BREWER, L			
SPK	R.E. METALS	49	601408	TRT	R.E. OXIDES	61	201358
PRANDTL, W				WARSHAW, I	ROY, R		
SPK	R.E. METALS	59	601352	VAP	R.E. OXIDES	62	601612
ANON				WHITE, D	WALSH, P		
SPK	R.E. METALS	57	601103	VAP	R.E. OXIDES	61	701039
BURBRIDGE, E				HASAPIS, A	MELVEGE		
THER	R.E. METALS	58	601080	VAP	R.E. OXIDES	60	300399
MCKEOWN, J				KULVARSKAYA, B	MAS		
VAP	R.E. METALS	58	601524	VAP	R.E. OXIDES	61	300653
ANON				SHCHUKAREV, S	SEME		
VAP	R.E. METALS	57	601308	VAP	R.E. OXIDES	60	601377
ANON				WHITE, D			
CRY5	R.E. METALS	61	201155	VAP	R.E. OXIDES	61	601409
WARSHAW, I				PANISH, M			
PHAS	R.E. METALS	61	201155	VAP	R.E. OXIDES	60	700566
WARSHAW, I				WALSH, P	N GOLDSTE		
MPP	R.E. NITRIDES	56	601048	MPP	RE	62	301627
GAUME-MAHN, F				ZEIDLER, E	KRAUT		
MPP	R.E. NITRIDES	62	301517	MPP	RE	62	301270
LAVALLE, D				KOPETSKIY, CH			
MPP	R.E. NITRIDES	62	301539	MPP	RE	62	301344
NACHMAN, J	LUNDIN			SAVITSKII, E			
REV	R.E. NITRIDES	56	601048	ERES	RE	61	201599
GAUME-MAHN, F				PIPPIG, E			
BIB	R.E. OXIDES	60	601450	BIB	RE	60	700723
KLEBER, E				WOHL, M			
CPL	R.E. OXIDES	62	601454	COPT	RE	62	201752
WESTRUM, E	JUSTICE			BATSANOVA, L	GRIGO		
CPL	R.E. OXIDES	61	601421	CPH	RE	61	700547
JUSTICE, B				FINCH, R			
CRY5	R.E. OXIDES	60	601450	CPH	RE	61	300349
KLEBER, E				BLANPAIN, R			
CRY5	R.E. OXIDES	61	601421	CPH	RE	61	201250
JUSTICE, B				TAYLOR, R			
CRY5	R.E. OXIDES	62	300803	CPL	RE	61	700547
MOZZI, R	GUENTERT			FINCH, R			
CTEX	R.E. OXIDES	61	201271	CPL	RE	61	300652
STECURA, S	CAMPBELL			BLANPAIN, R			
CTEX	R.E. OXIDES	61	601430	CPL	RE	61	201250
BROWN, W	KIRCHNER			TAYLOR, R			
ERES	R.E. OXIDES	36	601519	CRY5	RE	60	200801
HARTMANN, W				LAWLEY, A			
ERES	R.E. OXIDES	59	601124	CRY5	RE	62	300513
NODDACK, W	WALCH			FRANTSEVICH, I	SHI		

CRYB	RE			THER	RE COMPOUNDS		
FENG, C		62	201618	MCDONALD, J		62	300664
CRYB	RE			PHAS	RE C		
GLADYSHEVSKII, E TY		60	201564	NADLER, M KEMPTER		60	300301
CRYB	RE			REAC	RE CL6		
MATYUSHENKO, N		62	301160	COLTON, R		62	201684
ERES	RE			SPK	RE F 6		
FINCH, R		61	700547	CLAASSEN, H MALM		62	201656
ERES	RE			REAC	RE F 6		
TAYLOR, R		61	201260	NIKOLAEV, N IPPOLI		61	201676
MISC	RE			REAC	RE I		
HAMPEL, C		61	200889	FERGUSON, J ROBIN		62	201686
MPP	RE			PHAS	RE HF SYST		
PORT, J		60	700976	TAYLOR, A KAGLE, B		63	301000
PHAS	RE			PHAS	RE NB		
SAVITSKII, E TYLKI		62	301674	LEVESQUE, P		61	201149
PHAS	RE			THER	RE O		
SAVITSKII, E TYLKI		63	301676	SCHICK, H ANTHROP		62	300996
PHAS	RE			CRYB	RE O 2		
JAFFEE, R MAYKUTH		60	201286	DESCHANVRES, A		59	600848
PMCH	RE			PHAS	RE O 2		
PORT, J		60	700976	COEFFIR, G TRHORE		61	700648
REAC	RE			TRT	RE O 2		
CAMPBELL, I ROSEN B		59	200867	COEFFIER, G TRAORE		61	700648
REAC	RE			VAP	RE O 2		
FRANTSEVICH, I LAV		59	200869	DEEV, V SMIRNOV, V		61	301108
REAC	RE			CRYB	RE O 3		
THOMPSON, R		61	201058	DESCHANVRES, A		59	600848
REAC	RE			VAP	RE O 3		
LOVE, B KLEBER, E		61	201733	DEEV, V SMIRNOV, V		61	301108
REV	RE			CRYB	RE20 7		
GONSER, B		62	301459	DESC'IANVRES, A		59	600848
REV	RE			THER	RE20 7		
WOHL, M		60	701063	SCHICK, H ANTHROP		63	301679
REV	RE			REAC	RE OXIDE		
WOOLF, A		61	201232	COLTON, R		62	201683
REV	RE			CEMP	REFRACTORIES		
LEBEDEV, K		60	300828	LASHKAREV, G SAMSO		62	300566
REV	RE			CEMP	REFRACTORIES		
BOLES, S		62	201859	KISLY, P SAMSONOV		61	300496
REV	RE			COPT	REFRACTORIES		
TYLKINA, M POVAROV		61	201916	SEREBRYAKOVA, T I P		60	300136
SPK	RE			CPH	REFRACTORIES		
TREES, R		61	701067	WALKER, B EWING, C		62	301016
SPK	RE			MPP	REFRACTORIES		
ROSENZWEIG, N PORT		60	700996	SAMSONOV, G KOVALC		61	300986
SPK	RE			REAC	REFRACTORIES		
ROSENZWEIG, N PORT		60	700901	MAY, C KONEVAL, D		61	700686
SPK	RE			REAC	REFRACTORIES		
MOORE, C		58	601088	SAMSONOV, G UMANSK		62	201726
SPK	RE			REV	REFRACTORIES		
STUDIER, M		62	201608	KIEFFER, R BENESOV		63	301497
THEO	RE			REV	REFRACTORIES		
ROSENZWEIG, N PORT		60	700996	DEWTSCH, G AULT, G		62	301434
THEO	RE			REV	REFRACTORIES		
ROSENZWEIG, N PORT		60	700901	SAMSONOV, G		62	300981
THER	RE			REV	REFRACTORIES		
SCHICK, H ANTHROP		62	300996	KIEFFER, R BENESOV		63	301261
THER	RE			BOOK	REFRACTORIES		
WOOLF, A		61	201232	SAMSONOV, G		63	301342
THER	RE			REV	REFRACTORIES		
KING, J		60	200813	STORMS, E		62	301023
MPP	RE ALLOYS			THEO	REFRACTORIES		
SAVITSKY, Y TYLKINA		58	900230	BUDNIKOV, P BEREZH		63	900219
PHAS	RE AL SYST			THER	REFRACTORIES		
SAVITSKII, E TYLIN		61	300836	HOCH, M		61	700661
CRYB	RE3B						

MPP	REFRACTORY METALS				
BESSERER, C	58	700929			
PHAS	REFRACTORY METALS				
MURPHY, A KENNEDY	60	701041			
PMCH	REFRACTORY METALS				
MURPHY, A KENNEDY	60	701041			
REV	REFRACTORY METALS				
MURPHY, A KENNEDY	60	701041			
REV	REFRACTORY METALS				
NORTHCOTT, L	61	700582			
TCON	REFRACTORY METALS				
BESSERER, C	58	700929			
PHAS	RE TA SYST				
KAUFMANN, A R RAPPR	61	300218			
PHAS	RE V SYST				
TYLKINA, M POVAROV	60	200935			
PHAS	RE W C SYST				
HAVELL, R BASKIN	61	201235			
VAP	RE X				
SHIMAZAKI, E NIWA	62	201503			
VAP	RE X				
MALM, J SELIG, H	61	201502			
CEMP	RH				
WHITE, G WOODS, S	57	601050			
CPH	RH				
DOUGLASS, R HOLDEN	59	700375			
CPH	RH				
JAEGER, F	31	900139			
CPL	RH				
JOHNSON, R HUDSON	58	601039			
CPL	RH				
BORELIUS, G	60	601168			
CRYS	RH				
BALE, E	58	601083			
CRYS	RH				
MCCALDIN, J DUWEZ	54	600956			
CRYS	RH				
THOMPSON, J	62	201648			
DH	RH				
PANISH, M REIF, L	61	700639			
DH	RH				
HAMPSON, R WALKER	61	700681			
ERES	RH				
CHASTON, J	62	300577			
ERES	RH				
PRICE, E TAYLOR, B	62	601473			
ERES	RH				
BRIDGMAN, P	51	400533			
ERES	RH				
KEMP, W KLEMENS, P	59	601205			
MPP	RH				
EREMENKO, V NAIDIC	61	300529			
MPP	RH				
FRANCIS, A	62	301076			
PHAS	RH				
MENDENHALL, C INGE	07	900143			
PHAS	RH				
ROESER, W WENSEL	34	900141			
PHAS	RH				
RAUB, E BEESKOW, H	59	201473			
REV	RH				
SANDERSON, L	61	300377			
SPK	RH				
MURPHY, R	52	600946			
SPK	RH				
SANCHO, F	58	601092			
SPK	RH				
SHADMI, Y	61	700954			
SPK	RH				
SANCHO, F	58	601091			
SPK	RH				
MOORE, C	58	601088			
SPK	RH				
NORRIS, J	60	601194			
SPK	RH				
CATALAN, M RICO, F	57	601208			
TCON	RH				
WHITE, G WOODS, S	57	601050			
TCON	RH				
POWELL, R TYE, R	55	601082			
THER	RH				
SCHICK, H ANTHROP	62	300995			
THER	RH				
KEMP, W KLEMENS, P	59	601205			
REV	RH				
BETTERIDGE, W RHYS	62	202003			
THER	RH				
DOUGLASS, R HOLDEN	59	700375			
TRT	RH				
ORIANI, R JONES, T	54	600954			
TRT	RH				
MCCALDIN, J DUWEZ	54	600956			
TRT	RH				
ROESER, W WENSEL	34	900141			
TRT	RH				
MENDENHALL, C INGE	07	900143			
VAP	RH				
DREGER, L	62	300720			
VAP	RH				
DREGER, L MARGRAVE	61	201500			
VAP	RH				
HASAPIS, A PANISH	60	700994			
VAP	RH				
BABELIOWSKY, T	62	300858			
VAP	RH				
DREGER, L	61	300528			
VAP	RH				
DREGER, L MARGRAVE	60	600643			
VAP	RH				
PANISH, M REIF, L	61	700639			
VAP	RH				
HAMPSON, R WALKER	61	700681			
CRYS	RH B SYST				
ARONSON, B ASELIUS	59	601166			
VAP	RH CL SYST				
BELL, W TAGAMI, M	62	201476			
CPH	RH O				
WOHLER, L JOCHUM	33	900124			
DH	RH O				
WOHLER, L JOCHUM	33	900124			
DH	RH O				
WOHLER, L MULLER	25	900140			
THER	RH O				
SCHICK, H ANTHROP	62	300995			
THER	RH O 2				
ALCOCK, C HOOPER	60	601161			
CPH	RH2O				
WOHLER, L JOCHUM	33	900124			
DH	RH2O				
WOHLER, L JOCHUM	33	900124			
DH	RH2O				
WOHLER, L MULLER	25	900140			
CPH	RH2O 3				
WOHLER, L JOCHUM	33	900124			
DH	RH2O 3				
WOHLER, L JOCHUM	33	900124			
DH	RH2O 3				
WOHLER, L MULLER	25	900140			
THER	ROCKET ENGINES				
NIKOLAYEV, B	60	400615			
COPT	RU				
DOUGLAS, R W ADKIN	61	700614			
CRYS	RU				
LAWLEY, A	60	200801			
CRYS	RU				
MCCALDIN, J DUWEZ	54	600956			
CRYS	RU				
THOMPSON, J	62	201648			
MPP	RU				
FRANCIS, A	62	301076			
PHAS	RU				
DOUGLAS, R W ADKIN	61	700614			
SPK	RU				
TREES, R	61	701067			
SPK	RU				
SHADMI, Y	61	700954			

SPK	RU		
MOORE, C		58	601088
THER	RU		
MARGRAVE, J		61	700967
THER	RU		
ZOUBOV, N POURBAIX		58	601076
TRT	RU		
MCCALDIN, J DUWEZ		54	600966
VAP	RU		
PAULE, R		61	601479
VAP	RU		
HASAPIS, A MELVEGE		61	701039
VAP	RU		
MARGRAVE, J		61	700967
VAP	RU		
PANISH, M REIF, L		62	300721
CRYS	RU B SYST		
KEMPTER, C FRIES		61	701050
CRYS	RU B SYST		
ARONSON, B STENBER		62	300757
CRYS	RU B SYST		
KEMPTER, C FRIES		61	201103
MPP	RU B SYST		
BUDDERY, J WELCH		51	600940
PHAS	RU B SYST		
ROOF, R KEMPTER, C		62	300966
PHAS	RU B SYST		
OBROWSKI, W		63	301546
CRYS	RU C		
KEMPTER, C NADLER		60	701010
CRYS	RU C		
KEMPTER, C NADLER		60	201024
CRYS	RU C		
KEMPTER, C NADLER		60	201024
PHAS	RU C		
NADLER, M KEMPTER		60	300301
THER	RU O		
ALCOCK, C HOOPER		60	601161
DH	RU O 2		
SCHNEIDERETTL, G		62	301582
DH	RU O 2		
SCHAEFER, H SCHNEI		63	301577
SPK	RU O 4		
ORTNER, N ANDERSON		59	701066
THER	RU O 4		
ORTNER, N ANDERSON		59	701066
THER	RU O 4		
ZOUBOV, N POURBAIX		58	601076
TRT	RU O 4		
NIKOLSKII		63	301541
THER	RU OXIDES		
ORTNER, N ANDERSON		59	701066
VAP	RU OXIDES		
ORTNER, N ANDERSON		59	701066
PHAS	RU RE		
RUDY, E KIEFFER, B		62	201556
PHAS	RU RE		
SAVITSKII, E TYLKI		62	201631
PHAS	RU TA SYST		
KAUFMANN A R RAPPR		61	300218
PHAS	RU W SYST		
KAUFMANN A R RAPPR		61	300218

S

VAP	SC		
KRIKORIAN, O		63	301284
CEMP	SC		
MICHAELSON, H		50	400529
CPH	SC		
MARDON, P NICHOLS		61	701025
CPL	SC		
MONTGOMERY, H PELL		61	601447
CPL	SC		
LEBEDEV, V		48	700702

CPL	SC		
WELLER, W KELLEY		62	700704
CRYS	SC		
MARDON, P NICHOLS		61	701025
CRYS	SC		
SPEDDING, F DAANE		56	700703
CRYS	SC		
HERRMANN, K DAANE		55	700906
ERES	SC		
COLVIN, R ARAJS, S		63	301036
ERES	SC		
MARDON, P NICHOLS		61	701025
MPP	SC		
MARDON, P NICHOLS		61	200987
MPP	SC		
SPITSYN, V KOMISSA		61	300370
MPP	SC		
BORISENKO, I		61	300447
MPP	SC		
SPEDDING, F DAANE		60	700713
MPP	SC		
HILLER, M		60	700738
PHAS	SC		
BEAUDRY, B DAANE		62	300573
PHAS	SC		
FISCHER, W BRIINGE		37	700766
REAC	SC		
SPITSYN, V KOMISSA		61	300370
REV	SC		
SANDERSON, L		61	300376
REV	SC		
STRUAT K WEIK, H		60	601167
REV	SC		
VICKERY, R		60	601173
REV	SC		
LOVE, B		60	700735
REV	SC		
GEISELMAN, D		62	201941
SPK	SC		
ROSENZWEIG, N PORT		60	700996
SPK	SC		
MERRILL, P GREENST		56	601007
SPK	SC		
GARSTANG, R		52	100207
SPK	SC		
WRIGHT, K		48	100212
SPK	SC		
SKINNER, H		55	700761
SPK	SC		
ROSENZWEIG, N PORT		60	700901
THEO	SC		
ROSENZWEIG, N PORT		60	700996
THEO	SC		
ROSENZWEIG, N PORT		60	700901
TRT	SC		
BEAUDRY, B DAANE		62	300573
TRT	SC		
FISCHER, W BRIINGE		37	700766
VAP	SC		
KARELIN, V NESMEYA		62	300362
VAP	SC		
BEAVIS, L		60	600659
VAP	SC		
ACKERMANN, R RAUH		62	700840
VAP	SC		
KARELIN, V NESMEYA		62	601594
VAP	SC		
BEAVIS, L		60	701016
VAP	SC		
ACKERMANN, J RAUH		62	700909
THER	SC		
VASILEV, V ZOLOTAR		59	700823
CEMP	SC B 2		
KUDINTSEVA, G NESH		62	301514
CEMP	SC B 2		
SAMSONOV, G FOMENK		63	202128
CRYS	SC B 2		
ZHURAVLEV, N STEPA		58	700727

MPP	SC B 2			CPL	SI		
SAMSONOV, G		61	700728	KEESOM, P H	PEARLM	52	300170
TRT	SC B 2			CPL	SI		
SAMSONOV, G		61	700728	PEARLMAN, N	KEESOM	52	300171
PHAS	SC B 6			CPL	SI		
PRZYLYLSKA, M	REDD	63	300962	FLUBACHER, P	LEADB	59	300391
PHAS	SC BE13			CPL	SI		
LAUBE, E	NOWOTNY	62	201760	SHARAN, B	SINGH, S	60	600654
SURF	SC BORIDES			CRYS	SI		
FOMENKO, V		61	201420	GETTE, E	FOOTE, F	35	700510
MISC	SC C			DHT	SI		
NOWOTNY, H	ABER-WE	61	700651	DAVIS, S	ANTHROP	61	701009
MISC	SC C			ERES	SI		
SAMSONOV, G	MAKAVE	62	700744	GOLDSMITH, A	HIRSC	60	700930
PHAS	SC C			H	SI		
AVER-WELSBACH, H		61	201175	GOLDSMITH, A	HIRSC	60	700930
CRYS	SC F 3			KIN	SI		
AKISHIN, P	NAURMOV	61	201201	CHAPMAN, A		60	200810
SPK	SC F 3			MSP	SI		
AKISHIN, P	NAURMOV	61	201201	KOYLOVSKAYA, V			301103
THER	SC ION			MSP	SI		
VASILEV, V	ZOLO TAR	59	700823	LOWRIE, R		60	701014
MPP	SC N			PHAS	SI		
FRIEDERICH, E	SITT	25	700766	BEREZHNOI, A	KORDY	62	201553
REAC	SC N			PHAS	SI		
LYUTAYA, M	BUKHANE	62	301528	GELD, P	GERTMAN, Y	60	300417
CRYS	SC O			REV	SI		
VICKERY, R	SEDALEK	59	700707	BEREZHNOI, A		61	201469
F	SC O			SPK	SI		
BREWER, L	CHARDRAS	59	700721	ELYASHEVICH, M	NIK	56	301090
REAC	SC O			SPK	SI		
MASSONNE, J		61	201426	SHENSTONE, A		61	700636
SPK	SC O			SPK	SI		
AKERLIND, L		62	300611	NIKITINA, O		61	200818
SPK	SC O			SPK	SI		
AKERLIND, L		61	700635	HOLMES, J	HOOVER	62	300822
SPK	SC O			TCON	SI		
BERG, R	SIMANOGLN	60	301089	GOLDSMITH, A	HIRSC	60	700930
DH	SC20 3			TCON	SI		
HUBER, E	FITZGIBBO	63	301246	HOLLAND, M		61	201289
DH	SC20 3			THER	SI		
HUBER, E	FITZGIBBO	63	202057	CHERKASKIN, Y	GLAD	57	301107
CEMP	SC20 3			THER	SI		
MORIN, F		58	700710	SCHICK, H	ANTHROP	63	300994
CPL	SC20 3			THER	SI		
WELLER, W	KING, E	63	301817	SULLIVAN, R	SEIBEL	60	701038
CRYS	SC20 3			THER	SI		
MILLIGAN, W	VERNON	63	700756	WILLIAMS, N	N	61	700659
DH	SC20 3			TRT	SI		
HUBER, E	HOLLEY, C	62	700704	WENTORF, R	KASPER	63	301620
DH	SC20 3			TRT	SI		
MAH, A		62	700705	KANTOR, P	KISIL, O	60	300274
PHAS	SC20 3			VAP	SI		
BARTA, C	PETRU, F	58	700725	KOSENKO, V	NESTERE	61	600847
REAC	SC20 3			VAP	SI		
SPEDDING, F	POVELL	58	700757	ROTH, E	MARGERUM	62	300970
THER	SC20 3			VAP	SI		
KUBASHEVSKI, O	EVA	56	700829	POPPER, P		60	601632
TRT	SC20 3			VAP	SI		
BARTA, C	PETRU, F	58	700725	LOWRIE, R		60	701014
THEO	SEMICONDUCTORS			VAP	SI		
HARVEY, W		63	202047	DAVIS, S	ANTHROP	61	701009
BIS	SI			VAP	SI		
SULLIVAN, R	SEIBEL	60	701038	HANLIN, H		60	700951
CEMP	SI			CRYS	SI		
SAMSONOV, G	NESHPO	59	201052	JAMIESON, J		63</	

VAP	SI C		
DROWART, J	DEMARIA	60	200770
THER	SI C		
GRIEVESON, P	ALEOC	60	301060
CRYS	SI C		
JAGODZINSKI, H	ARN	60	200898
KIN	SI C		
JORGENSEN, P		60	200924
KIN	SI C		
JORGENSEN, P	WADSW	60	200772
DF	SI C		
KIRKWOOD, D	K CHIP	61	700634
CRYS	SI C		
KRISHNA, P	VERMA	61	701058
SPK	SI C		
OVCHARENKO, I	TUNI	60	600778
THER	SI C		
POPPER, P		60	601632
COPT	SI C		
SAMSONOV, G	PENKOV	61	300800
CPL	SI C		
SHMIDT, N	SOKOLOV	60	201590
DF	SI C		
SMILTENS, J		60	301059
DH	SI C		
SMILTENS, J		60	200771
THER	SI C		
SMILTENS, J		60	200771
VAP	SI C		
SMILTENS, J		60	200771
ZKP	SI C		
SMILTENS, J		60	200771
BIB	SI C		
SULLIVAN, R	SEIBEL	60	701038
THER	SI C		
SULLIVAN, R	SEIBEL	60	701038
CRYS	SI C		
TAYLOR, A	JONES, R	60	200776
CTX	SI C		
TAYLOR, A	JONES, R	60	200776
CRYS	SI C		
TOMITA, T		60	600801
THEO	SI C		
TSERTSVADZE, A	TCH	62	300583
SPK	SI C		
VIDALE, G		60	201616
VAP	SI C		
VIDALE, G		60	201616
MPP	SI C		
VORONIN, N		61	301007
CPH	SI C		
WALKER, B	EWING, C	62	301098
PHAS	SI C		
YASUDA, S		62	300581
THER	SI CARBIDES		
SAMSONOV, G		59	201343
DH	SI CARBIDES		
DROEGE, J		60	201160
PHAS	SI C SYST		
SEARCY, A	FINNE, L	62	201874
PHAS	SI C SYST		
DOLLOFF, R		60	700989
PHAS	SI C SYST		
DOLLOFF, R		60	600662
REAC	SI C SYST		
KUHN, W		63	300919
DH	SI C SYST		
SCACE, R	SLACK, G	60	200768
PHAS	SI C SYST		
SCACE, R	SLACK, G	60	200768
PHAS	SI C O SYST		
KRIVSKY, W	SCHUMAN	61	300459
MPP	SILICATES		
LIPMAN, R		59	400596
MPP	SILICIDES		
SAMSONOV, G		59	202126
CRYS	SILICIDES		
NESHPOR, V	SAMSONO	62	202108

CRYS	SILICIDES			CPL	SI O 2		
LUNDIN, C		61	202089	WESTRUM, E		60	701021
CPH	SILICIDES			CRYS	SI O 2		
GELD, P KRENTSIS		63	202037	SCLAR, C CARRISON		62	301584
CRYS	SILICIDES			CRYS	SI O 2		
GLADYSHEVSKII, E		63	202040	FLOERKE, O		62	301449
CRYS	SILICIDES			CRYS	SI O 2		
NESHPOR, V		61	300792	ANIKINA, I		62	301173
DH	SILICIDES			CRYS	SI O 2		
GOLUTVIN, Y		62	300567	ARNOLD, H		62	301175
MPP	SILICIDES			MPP	SI O 2		
SAMSONOV, G		59	400619	NAGARJAN, G		63	202106
PHAS	SILICIDES			REAC	SI O 2		
PORTNOY, K		60	700944	LEONOV		61	301522
REV	SILICIDES			SPK	SI O 2		
SAMSONOV, G		62	300989	SODA, R		62	301591
CRYS	SILICIDES-PT MET			THER	SI O 2		
ARONSSON, B RUNDQV		61	300504	SCHICK, H ANTHROP		63	301580
CRYS	SI N			THER	SI O 2		
BORGEN, O SEIP, H		61	201514	SCHICK, H		60	202130
SPK	SI N			CRYS	SI O 2		
STEVENS, A FERGUSO		63	202143	SMITH, G ALEXANDER		63	202139
REAC	SI N			CRYS	SI O 2		
HENGGE, E		62	201759	SMITH, G		63	202140
VAP	SI3N 4			MPP	SI O 2		
FESENKO, V BOLGAR		63	301216	STEPIN, B		63	202142
REV	SI3N 4			REAC	SI O 2		
RABENAU, A		63	301324	KAY, D TAYLOR, J		63	202066
CTEX	SI3N 4			REAC	SI O 2		
IWAI, S YASUNAGA		59	700684	KOMATSU, N GRANT		62	202077
THER	SI NITRIDES			PHAS	SI O 2		
SAMSONOV, G		59	201343	BEREZNOI, A GULKO		61	202002
ERES	SI N SYST			TRT	SI O 2		
SAMSONOV, G		61	601585	SCLAR, C CARRISON		62	301585
PHAS	SI N SYST			TRT	SI O 2		
SAMSONOV, G		61	601585	CHAKLADER, A		63	301425
DF	SI O			TRT	SI O 2		
WHATLEY, L		62	201679	CHAKLADER, A		63	301426
DH	SI O			TRT	SI O 2		
BERGMAN, G MEDVEDE		59	300674	CHAKLADER, A		63	301201
DH	SI O			PHAS	SI O 2		
BERGMAN, G MEDVEDE		59	300674	DACHILLE, F ROY, R		59	301210
MPP	SI O			CPH	SI O 2		
YORK, D		63	301019	MITKINA, E		60	301306
PHAS	SI O			TRT	SI O 2		
BREWER, L MASTIK		49	601634	SEMENCHENKO, V		61	301349
PHAS	SI O			CRYS	SI O 2		
BRCIC, B GOLIC, L		62	201636	STISHOV, S BELOV		62	301363
PHAS	SI O			DH	SI O 2		
CHAPMAN, A ST PIER		60	301427	WISE, S MARGRAVE		63	301381
REAC	SI O			CPL	SI O 2		
EMONS, H BOENICKE		62	300562	CLARK, A STRAKNA		62	300580
REAC	SI O			CRYS	SI O 2		
WHITE, P		62	300732	EMONS, H BOENICKE		62	300562
SPK	SI O			CRYS	SI O 2		
NICHOLLS, R		62	601625	HOLMQUIST, S B		61	700517
SPK	SI O			CRYS	SI O 2		
NICHOLLS, R		62	300698	PREISINGER, A		62	300963
SPK	SI O			CRYS	SI O 2		
MCGREGOR, A NICHOL		61	300475	TROMEL, G KRISEMEN		59	700690
SPK	SI O			CRYS	SI O 2		
JAMES, T		63	301481	STISHOV, S POPOVA		61	201716
SPK	SI O			DH	SI O 2		
JAMES, T		63	301252	WISE, S		62	300741
SPK	SI O			DH	SI O 2		
BARROW, R ROWLINSON		54	600896	GOOD, W		62	

MPP	SI O 2			DH	SM		
	GREBENSHCHIKOV, R	60	200973		SAVAGE, W HUDSON	59	601126
PHAS	SI O 2			ERES	SM		
	GIELISSE, P	62	201740		OLSEN, C	60	601336
PHAS	SI O 2			ERES	SM		
	ARAMAKI, S ROY, R	62	201896		ALSTAD, J COLVIN	61	201099
PHAS	SI O 2			SPK	SM		
	TROMEL, G KRISEMEN	59	700690		DREYFUS, B GOODMAN	61	601417
PHAS	SI O 2			SPK	SM		
	MORIYA, Y		201363		SCHWARZSCHILD, M	57	601047
PHAS	SI O 2			SPK	SM		
	KHLAPOVA, A	62	301146		BURBRIDGE, E BURBR	56	601003
PHAS	SI O 2			SPK	SM		
	KHLAPOVA, A	61	201848		SMITH, K SPALDING	62	300777
PHAS	SI O 2			SPK	SM		
	TOROPOV, N GALAKHO	61	201966		GARSTANG, R	52	100207
REAC	SI O 2			SPK	SM		
	KAY, D TAYLOR, J	60	300131		MCNALLY, J	52	100211
SPK	SI O 2			SPK	SM		
	MARKIN, E SOBOLEV	60	200979		SMITH, D MCNALLY	50	100197
SPK	SI O 2			SPK	SM		
	SODA, R	61	201302		BRIX, P	49	400527
TCON	SI O 2			SPK	SM		
	WRAY, K CONNOLLY	59	600620		BRIX, P KOPFERMANN	49	400543
THER	SI O 2			SPK	SM		
	KAY, D TAYLER, J	60	300131		GRATTON, L	52	400567
TRT	SI O 2			SPK	SM		
	BOYD, F ENGLABD, J	63	301193		BRIX, P KOPPERMAN	52	400574
THER	SI O 2			SPK	SM		
	MACKENZIE, J D	60	300139		BODMER, A	54	600936
THER	SI O 2			SPK	SM		
	RAMSTAD, H RICHARD	61	300339		SFRIGANOV, A KATUL	62	601468
VAP	SI O 2			SPK	SM		
	NESMEYANOV, A FIRS	60	200953		MURAKAWA, K	54	600958
VAP	SI O 2			SPK	SM		
	FIRSOVA, L NESMEYA	60	701004		DIEKE, G SARUP, R	62	201718
VAP	SI O 2			SPK	SM		
	FIRSOVA, L NESMEY	60	200761		FEDOFILOV, P KAPLY	62	201755
PHAS	SI2O 3			THER	SM		
	DADAPE, V MARGRAVE	62	300551		SPEDDING, F H MCKE	60	700570
PHAS	SI2O 3			TRT	SM		
	CREMER, E FAESSLER	59	201034		ANON	53	601502
SURF	SI OXIDES			VAP	SM		
	LEPINSKIKH, B	60	201215		ANON	56	601319
VAP	SI OXIDES			VAP	SM		
	FIRSOVA, L NESMEYA	60	201020		SAVAGE, W HUDSON	59	601126
VAP	SI OXIDES			PHAS	SM B 4		
	NESMEYANOV, A FIRS	59	201019		GALLOWAY, G	62	701078
PHAS	SI O SYST			REAC	SM B 4		
	FLOERKE, O	61	301220		GALLOWAY, G	62	701078
MPP	SI O SYST			CEMP	SM B 6		
	APPEN, A KAJALOVA	62	300589		SAMSONOV, G PADERN	59	300143
THEO	SI O SYST			ERES	SM B 6		
	VORONKOV, M	61	301004		PADERNO, Y SAMSONO	61	301072
CPH	SI V SYST			PHAS	SM B 6		
	GOLUTVIN, Y KOZLOV	62	300568		GALLOWAY, G	62	701078
SPK	SIMPLE MOLECULES			REAC	SM B 6		
	DOUGLAS, A	55	600678		SAMSONOV, G ZHURAV	59	201758
CPH	SM			CRYS	SM B SYST		
	ARAJA, S COLVIN, R	62	300751		ANON	61	601378
CPH	SM			CRYS	SM N		
	JENNINGS, L HILL	59	601197		EICK, H BAENZIGER	56	601046
CPL	SM			ERES	SM N		
	DREYFUS, B GOODMAN	61	601417		DIDCHENKO, R GORTS	63	301435
CPL	SM			PHAS	SM N		
	ROBERTS, L	57	601089		EICK, H BAENZIGER	56	601046
CPL	SM			REAC	SM N		
	LOUNASMAA, O	62	300780		EICK, H BAENZIGER	56	601046
CRYS	SM			REAC	SM NITRIDES		
	DAANE, A RUNDLE, R	53	601215		EICK, H	57	601053
CRYS	SM			CRYS	SM O		
	DAANE, A RUNDLE, R	54	601230		ELLINGER, F ZACHAR	53	600947
CRYS	SM			VAP	SM O		
	ELLINGER, F ZACHAR	53	600947		KULVARSHAYA, B MAS	60	301064
DH	SM			SPK	SM2		
	HUBER, E	55	601272		BURBRIDGE, G BURBR	54	600937
DH	SM			CPH	SM2O 3		
	HUBER, E MATTHEWS	55	601008		PANKRATZ, L KING	62	300958

CPL	SM20 3			THEO	SPECIFIC HEAT		
JUSTICE, B WESTRUM		63	300907	ROSENSTOCK, H B		61	700843
CRYS	SM20 3			THEO	SPECTRA		
STARITZKY, E		56	601257	MASON, S		61	201224
CRYS	SM20 3			THEO	SPECTROSCOPY		
KUTSEV, V SMAGINA		63	301515	GRIBOV, L		62	900220
CRYS	SM20 3			THEO	SPECTROSCOPY		
CROMER, D		57	601304	VARSHNI, V P SHUKL		61	700598
CRYS	SM20 3			BETA	SR		
CROMER, D		57	601082	EVDOKIMOVA, V VERE		60	201072
CRYS	SM20 3			SPK	SR		
DOUGLASS, R STARIT		56	601011	PENKIN, N SHABANOV		62	601601
CTEX	SM20 3			SPK	SR		
PLOETZ, G		57	601309	CODLING, K		61	600775
MSP	SM20 3			SPK	SR		
PANISH, M		61	601372	SHADMI, Y		61	700954
TRT	SM20 3			VAP	SR		
WISNYI, L PIJANOWS		57	601056	KOZHEVNIKOV, G		63	301510
VAP	SM20 3			CEMP	SR B 6		
PANISH, M		61	601372	JOHNSON, R DAANE		63	301489
PHAS	SM OXIDES			DH	SR B 6		
EICK, H BAENZIGER		56	601070	SAMSONOV, G SEREBR		61	601581
REAC	SM OXIDES			ERES	SR B 6		
EICK, H BAENZIGER		56	601070	SAMSONOV, G SEREBR		61	601581
REAC	SM OXIDES			THER	SR B 6		
EICK, H		57	601053	BOLGAR, A		61	700938
BIB	SN OXIDES			VAP	SR B 6		
JONES, P		60	200984	SAMSONOV, G SEREBR		61	601581
CRYS	SM O SYST			VAP	SR B 6		
EICK, H		56	601289	BOLGAR, A		61	700938
PHAS	SM O SYST			CRYS	SR2MG17		
EICK, H		56	601289	KRIPYAKEVICH, P			201670
MPP	SOLAR FURNACE			PHAS	SR MG SI SYST		
MANVELYAN, M MELIK		61	400606	DEAR, P		60	201548
THEO	SOLID STATE			DH	SR O		
DEKHTYAR, I		59	300411	MAH, A		63	202093
CEMP	SOLIDS			E	SR O		
KUCHEROV, R YA RIK		60	300154	LAGERQVIST, A HULD		54	600681
CPH	SOLIDS			ERES	SR O		
IVANOVA, L I		61	300249	ADAMS, M JACOB, L		60	200763
THER	SOLIDS			SPK	SR O		
GLUSHKO, V		62	301221	LAGERQVIST, A ALMK		54	600680
THEO	SOLIDS			SPK	SR O		
IVERONOVA, V ZOYAG		63	202061	NICHOLLS, R		62	300698
THER	SOLIDS			SPK	SR O		
MARINCHUK, A MOSKA		63	202092	HULDT, L LAGERQVIS		55	600893
CPH	SOLIDS			SPK	SR O		
LANDIYA, N TSAGARE		62	301516	HULDT, L LAGERQVIS		56	600894
CPH	SOLIDS			SPK	SR O		
ROSENSTOCK, H		61	301563	VEITS, I GURVICH		57	600899
CRYS	SOLIDS			SPK	SR O		
BRADLEY, J		63	301411	ALMQVIST, G LAGERQ		49	600922
DH	SOLIDS			THER	SR O		
VOROBIEV, A PRIVA		60	300135	SCHICK, H ANTHROP		62	300995
PHAS	SOLIDS			VAP	SR O		
SCHAFER, K		60	300133	METSON, G		63	301536
PHAS	SOLIDS			CEMP	SR OXIDES		
IVANOVA, L I		61	300249	PALGUEV, S NECEIMI		62	201717
PHAS	SOLIDS			DHD	SR OXIDES		
DEVRIES, K BAKER		60	600665	VEITS, I GURVICH		56	700964
REAC	SOLIDS			THER	SR OXIDES		
BUDNIKOV, P GINSTL		61	300315	VEITS, I GURVICH		56	700964
REV	SOLIDS			THER	SR OXIDES		
SWALIN, R		62	300703	ORTNER, N ANDERSON		59	701066
THEO	SOLIDS			VAP	SR OXIDES		
SCHAFER, K		60	300133	ORTNER, N ANDERSON		5	

THEO SYSTEMS
NECKEL, A

61 300509

T

BOOK TA
SAMSONOV, G KONSTA 61 301570
CPH TA
JOHNSON, R 60 301488
CPL TP
FEATHERSTON, F NEI 63 301444
MPP TA
FRERICH, R 62 301450
MPP TA
KOPETSKIY, CH. 62 301270
CPH TA
KRAFTMACHER, IA 62 301282
VAP TA
CANO, G 62 301423
BETA TA
KRUPNIKOU, K BAKAN 63 301149
BIB TA
WENSRICH, C 60 700972
BIB TA
ANON 60 701022
BIB TA
WOHLL, M 60 700723
BIB TA
WENSRICH, O 60 700890
CEMP TA
RICKERT, E BECKETT 49 601638
CPH TA
FINCH, R 61 700547
CPH TA
RASOR, N MCCLELLAN 60 700896
CPH TA
LEHMAN, G 60 300304
CPH TA
CARTER, W 61 601631
CPH TA
HOCH, M 61 201167
CPH TA
RASOR, N MCCLELLAN 60 700984
CPH TA
TAYLOR, R 61 201250
CPL TA
FINCH, R 61 700547
CPH TA
HOCH, M JOHNSTON 61 700813
CPL TA
TAYLOR, R 61 201250
CPL TA
BORELIUS, G 60 601168
CPL TA
BOORSE, H BERMAN 55 700887
CPL TA
COCHRAN, J 62 201877
CRYS TA
VASUTINSKY, B KART 62 301009
CRYS TA
EDWARDS, J SPEISER 51 601179
CRYS TA
FERRISS, D ROSE, R 62 301137
CTEX TA
EDWARDS, J SPEISER 51 601179
CTEX TA
CARTER, W 61 601631
CTEX TA
RASOR, N MCCLELLAN 60 700984
SPK TA
CLAUS, H ULMER, K 63 202017
CTEX TA
NOWOTNY, H LAUBE 61 600844
ELCH TA
MONNIER, R GRANDJE 60 200949

ERES TA
FINCH, R 61 700547
ERES TA
BRIDGMAN, P 51 400532
ERES TA
TYE, R 61 201117
ERES TA
TAYLOR, R 61 201250
KIN TA
KOFSTAD, P 61 201400
MISC TA
HAMPEL, C 61 200889
MISC TA
BASKIN, M TRETYAKO 62 201951
MPP TA
RICKERT, E BECKETT 49 601638
MPP TA
RASOR, N MCCLELLAN 60 700896
MPP TA
ARGENT, B MILNE, G 60 201039
MPP TA
RILEY, W MCCLELLAN 62 301080
MPP TA
MYERS, R 50 600130
PHAS TA
HAWORTH, C 60 201017
PHAS TA
SHAFFER, P 61 700841
PHAS TA
ERBEN, E LESSER, R 61 300323
PHAS TA
ROSTOKER, W 60 201396
PHAS TA
VASYUTINSKII, B 62 201776
PMCH TA
BOLEF, D 61 200936
PREP TA
MILLER, G 62 201943
REAC TA
MILLER, G 60 200834
REAC TA
DEUTSCH, N NERVIN 60 600123
REAC TA
COWGILL, M STRINGE 60 600122
REAC TA
FRANTSEVICH, I LAV 59 200869
REAC TA
FAIRBROTHER, F COW 59 200886
REAC TA
KUBASCHEWSKI, O HO 60 201038
REAC TA
SCHAFFER, H SIBBING 60 201085
REAC TA
ENGELKE, J HALDEN 60 201529
REAC TA
KONSTANTINOV, V 62 301148
REV TA
BARTLETT, E SCHMID 61 701052
REV TA
WOHLL, M 60 701053
REV TA
ERBEN, E LESSER, R 61 300323
REV TA
SYRE, R 61 201579
SPK TA
ALLEN, R GLASIER 60 200828
SPK TA
ROSENZWEIG, N PORT 60 700996
SPK TA
TREES, R 61 701067
SPK TA
ROSENZWEIG, N PORT 60 700901
SPK TA
MOORE, C 58 601088
SPK TA
KIESS, C 62 201678
ICON TA
RASOR, N MCCLELLAN 60 700984

TCON	TA			MPP	TA C		
RASOR, N MCCLELLAN		60	700896	DERGUNOVA, V KOLON		63	202026
TCON	TA			CRYS	TA C		
TYE, R		61	201117	BOWMAN, A		61	600836
TCON	TA			ERES	TA C		
CONNOLY, A MENDELS		62	201536	COOPER, J HANSLER		63	301207
THEO	TA			VAP	TA C		
ROSENZWEIG, N PORT		60	700996	FESENKO, V BOLGAR		63	301216
THEO	TA			DH	TA C		
ROSENZWEIG, N PORT		60	700901	HUBER, E HEAD, E		63	301248
THER	TA			CEMP	TA C		
SCHICK, H ANTHROP		63	300994	INGOLD, J		63	301251
THER	TA			REAC	TA C		
CARTER, W		62	300749	SAMSONOV, G			301571
THER	TA			REAC	TA C		
CARTER, W		61	601631	SAEKI, Y OMORI, G		63	301339
THER	TA			THER	TA C		
RASOR, N MCCLELLAN		60	200960	SCHICK, H ANTHROP		63	301580
TRT	TA			DH	TA C		
WILLIAMS, D JACKSO		62	301016	KORNILOV, A LEONID		62	300923
TRT	TA			DHD	TA C		
MCMASTERS, O LARSE		61	600834	BITTNER, H GORETZK		62	301132
VAP	TA			MPP	TA C		
GEBHARDT, E SEGHEZ		62	601676	NORTON, J MOWRY, A		49	300167
VAP	TA			PHAS	TA C		
BABELIOWSKY, T		62	300858	BENESOVSKY, E RUDY		61	100181
KIN	TA SYST			PHAS	TA C		
KUBASCHEWSKI, O		62	601577	NADLER, M KEMPTER		60	300301
THER	TA SYST			PHAS	TA C		
KUBASCHEWSKI, O		62	601577	SHAFFER, P		61	700941
PHAS	TA AL C			PHAS	TA C		
JEITSCHKO, W NOWOT		63	301486	SHAFFER, P		61	701067
THER	TA B			PHAS	TA C		
LEITNAKER, J BOWMA		62	300553	NORTON, J		60	701001
THER	TA B			PHAS	TA C		
MEERSON, G		60	300298	ZALABAK, C		61	701026
CEMP	TA B 2			PHAS	TA C		
MATSKEVICH, T KRAC		62	301533	MARTIN, R SEAGLE		61	300308
H	TA B 2			PHAS	TA C		
MEZAKI, R TILLEUX		62	601617	RYBALCHENKO, R TRE		61	300346
MPP	TA B 2			SPK	TA C		
MALYUCHKOV, O POVI		62	202096	COFFMAN, J KIBLER		60	700993
S	TA B 2			THER	TA C		
MEZAKI, R TILLEUX		62	601617	COFFMAN, J KIBLER		60	700993
CRYS	TA3B 2			TRT	TA C		
KIEFFER, B BENESOV		58	600819	ZALABAK, C		61	200988
DH	TA BR5			TWT	TA C		
SHCHUKAREV, S SMIR		60	200799	MARTIN, R SEAGLE		61	300308
DH	TA BR5			VAP	TA C		
GROSS, P HAYMAN, C		62	300706	COFFMAN, J KIBLER		60	700966
PHAS	TA2B SYST			VAP	TA C		
LEITNAKER, J BOWMA		61	700596	COFFMAN, J KIBLER		60	700993
PHAS	TA B SYST			THER	TA2C		
NOWOTNY, H BENESOV		59	201339	SCHICK, H ANTHROP		63	301580
PHAS	TA B SYST			PHAS	TA2C		
LEITNAKER, J BOWMA		61	700596	KLEIN, R LEDER, L		63	301501
REAC	TA B SYST			DF	TA CL5		
SAMSONOV, G STRASH		62	300990	JERE, G PATEL, C		60	200860
VAP	TA B SYST			DH	TA CL5		
HASAPIS, A MELVEGE		61	701039	SHCHUKAREV, S SMIR		60	200799
MISC	TA B C SYST			THER	TA C SYST		
FORNEY, G J MARSHA		61	300238	CUNNINGHAM, G WARD		63	301208
COPT	TA C			PHAS	TA C SYST		
COFFMAN, J KIBLER		60	700986	VAUGHAN, D STEWAR		60	700990
COPT	TA C			PHAS	TA C SYST		
HODDAD, R E GOLDWA		49	300160	NADLER, M KEMPTER		60	700903
COPT	TA C			REAC	TA C SYST		
ECKSTEIN, B FORMAN		62	300806	SAMSONOV, G STRASH		62	300990

PHAS	TB O SYST			ERES	TH		
BAENZIGER, N C EIC		61	300184	BENDER, D		49	601404
CRYS	TC			ERES	TH		
LAM, D DARBY, J		61	601586	MURK, K		59	601523
MISC	TC			ERES	TH		
MURIN, A N NEFEDOV		61	700574	BOESCHOTEN, F		59	601528
PHAS	TC			ERES	TH		
SZABO, Z LAKATOS		62	601673	BERLINCOURT, T		59	601655
MPP	TC			ERES	TH		
EAKINS, J HUMPHRIE		63	301214	DANFORTH, W MORGAN		60	400635
PHAS	TC			H	TH		
ANDERSON, E BUCKLE		60	700975	OELSEN, W		55	600980
REV	TC			KIN	TH		
MURIN, A N NEFEDAV		61	700574	PETERSON, D		61	201246
SPK	TC			MPP	TH		
SHADMI, Y		61	700954	FRANCIS, E		58	601536
THER	TC			MPP	TH		
SCHICK, H ANTHROP		62	300995	MURRAY, J		58	601094
THER	TC			MPP	TH		
MARGRAVE, J		61	700967	SMITH, J		58	601073
TRT	TC			MPP	TH		
SZABO, Z LAKATOS		62	601673	SKINNER, G BECKETT		50	601225
SPK	TC F 6			PHAS	TH		
CLAASSEN, H SELIG		62	201854	ANON		62	601629
THER	TC O			PHAS	TH		
SCHICK, H ANTHROP		62	300995	ANON		57	601305
DH	TE			PHAS	TH		
WHITE, D		61	201217	WILSON, W AUSTIN		56	601071
SPK	TE			PHAS	TH		
NORRIS, J		60	601194	VON BOLTON, W		08	800117
REAC	TE C			PHAS	TH		
TRZEBIATOWSKI, W		62	201857	MARDEN, J RENTSCHL		27	900119
BIB	TH			PHAS	TH		
DAVID, L		63	600957	SCHULTZE, A		30	900117
CRYS	TH			PHAS	TH		
AMONENKO, V VASYUT		63	301170	BADAEVA, T		61	201890
CEMP	TH			REAC	TH		
FRANCIS, E		58	601536	DEYE, R		50	601156
CEMP	TH			REAC	TH		
MESMARD, G UYAN, R		51	400558	DEUTSCH, N ERVIN		60	500123
CEMP	TH			REAC	TH		
RIVIERE, J		62	201806	MURRAY, J		58	601094
C ^{PH}	TH			REV	TH		
MITKINA, E		59	201029	KAUFMANN, A		62	601429
CPH	TH			REV	TH		
WALLACE, D C		60	300132	ROLLEFSON, G HAGFM		51	601106
CPH	TH			REV	TH		
WALLACE, D C		60	700569	MURRAY, J		58	601094
CPL	TH			REV	TH		
CLUSIUS, K FRANZOS		56	601038	KATZIN, L		56	601020
CPL	TH			REV	TH		
GRIFFEL, M SKOCHDO		53	600966	SANDERSON, L		61	300375
CPL	TH			REV	TH		
SMITH, P WOLCOTT		55	601137	FRANCIS, E		58	601536
CPL	TH			REV	TH		
BORELIUS, G		60	601168	FRANCIS, E		58	601127
CRYS	TH			REV	TH		
SMITH, J		58	601073	VETEJSKA, K		60	601187
CRYS	TH			REV	TH		
DAWSON, J		62	100187	RYABCHIKOV, D GOL		61	700656
CRYS	TH			SPK	TH		
CHIOTTI, P		54	601198	CHARLES		58	601084
CRYS	TH			SPK	TH		
ANON		57	601297	KLINKENBERG, P LANG		50	400622
CRYS	TH			SPK	TH		
THOMPSON, J		62	201648	DAVISON, A GIACCHE		62	300623
CRYS	TH			SPK	TH		
CHIOTTI, P		54	01227	STUKENBROEKER, G M		50	601383
CRYS	TH			SPK	TH		
MCCALDIN, J DUWEZ		54	600956	NORRIS, J		60	601194
CTEX	TH			SPK	TH		
WILSON, W AUSTIN		58	601071	ZABULAS, R		59	601192
DH	TH			SPK	TH		
HOLLEY, C HUBER, E		50	601178	KLINKENBERG, P		60	400631
DH	TH			SPK	TH		
HUBER, E V HOLLEY		62	400655	ANON		58	601649
ERES	TH			SPK	TH		
ANON		55	601312	RACAH, G		50	400647

SPK TH				PHAS TH B O SYST			
OSARO, F PERLMAN	52	400572		RASE, D	60	600872	
SPK TH				PHAS TH BE C SYST			
KESSLER, D	51	400576		BRISI, C ABBATTIST	61	201507	
SPK TH				PHAS TH BE			
EISENBERG, Y	52	400577		BADAEVA, T KUZNETS	61	201833	
SPK TH				PHAS TH BE			
TREES, R	60	600852		BADAEVA, T KUZNETS	61	201891	
SPK TH				PHAS TH C			
VERNYL, E EGOROV	59	601189		KEMPTER, C KRIKORI	62	300517	
SPK TH				REAC TH C			
ELYASHEVICH, M	53	601413		SAMSONOV, G KASALA	60	700376	
SPK TH				REV TH C			
PISTORIUS, C	60	200864		ROUGH, F CHUBB, W	60	600810	
SPK TH				CRY8 TH C 2			
SCHUURMANS, P	46	601290		HUNT, G B RUNDLE	51	400573	
TCON TH				DF TH C 2			
SIDELES, P DANIELS	51	601238		ANON	60	601337	
THER TH				VAP TH C 2			
SCHICK, H ANTHROP	62	300995		MIKHAILOVSKII, B	63	301302	
THER TH				DF TH C 2			
CHIOTTI, P	56	601324		MASLAN, F	59	601354	
THER TH				DF TH C 2			
ACKERMANN, R THORN	62	601616		ANON	59	600608	
THER TH				DM TH C 2			
PETERSON, D	61	201246		PRESCOTT, C HINCKE	27	900116	
THER TH				PHAS TH C 2			
MARGRAVE, J	61	700967		ANON	60	601414	
THER TH				PHAS TH C 2			
SMITH, J	58	601073		KEMPTER, C KRIKORI	62	300517	
THER TH				PHAS TH C 2			
DARNELL, A J MCCOL	60	700567		PRESCOTT, C HINCKE	27	900116	
TRT TH				THER TH C 2			
MCCALDIN, J DUWEZ	54	600956		ANON	60	601458	
TRT TH				THER TH C 2			
REID, A WILMHURST	63	301556		ANON	60	601414	
TRT TH				TRT TH C 2			
DEYE, R	50	601156		PRESCOTT, C HINCKE	27	900116	
TRT TH				MPP TH CARBIDES			
SCHULTZE, A	30	900117		SKINNER, G BECKETT	50	601225	
TRT TH				REAC TH CARBIDES			
MCMASTERS, O LARSE	61	600834		WILHELM, H CHIOTTI	49	400536	
TRT TH				PHAS TH C SYST			
MARDEN, J RENTSCHL	27	900119		ROGERS, B	50	601266	
VAP TH				PHAS TH C SYST			
DARNELL, A	61	201182		MICKELSON, R PETER	57	601057	
VAP TH				PHAS TH C SYST			
ACKERMANN, R THORN	62	601616		CHIOTTI, P	52	100204	
VAP TH				PHAS TH C SYST			
TOSIM, S	57	601505		WILHEM, H CHIOTTI	50	400521	
VAP TH				TRT TH C SYST			
DARNELL, A J MCCOL	60	700567		WILHEM, H CHIOTTI	50	400521	
VAP TH				TRT H C SYST			
MURBACH, E	57	601105		CHIOTTI, P	52	100204	
VAP TH				BIB TH C SYST			
GOLDWATER, D DANFO	60	600691		COMSTOCK, M	60	600623	
VAP TH				PHAS TH CE			
VON BOLTON, W	08	800117		BADAEVA, T KUZNETS	61	201897	
MPP TH				PHAS TH CE LA SYST			
ROUGH, F A CHUBB	60	700568		EVANS, D RAYNOR, G	62	201812	
CRY8 TH B 4				SPK TH I			
ZALKIN, A TEMPELTO	53	100198		ZABULAS, R	59	601192	
CRY8 TH B 4				PHAS TH F 4			
ZALKIN, A TEMPLETO	50	601410		KIRSHENBAUM, A	61	201183	
CRY8 TH B 4				PHAS TH MMSYST			
ZALKIN, A TEMPLETO	50	400520		MCMASTERS, O PALME	62	301535	
REV TH B 4				PHAS TH MO C			
MATTERSON, K JONES	61	300324		RUDY, E BENESOVSKY	63	301566	
CEMP TH B 6				PHAS TH MO C SYST			
LAFFERTY, J	50	400541		RUDY, E BENESOVSKY	63	301332	
MPP TH B 6				REAC TH MG SYST			
SAMSONOV, V ZOUNA	56	601051		UNSWORTH, W	60	200876	
REAC TH B 6				CRY8 TH N			
SAMSONOV, V ZOUNA	56	601051		CHIOTTI, P	52	601237	
PHAS TH BORIDES				THEO TH N			
BREWER, L SAWYER	50	601400		BAUGHAN, E	59	300866	
PHAS TH B C SYST				TRT TH N			
TOTH, L BENESOVSKY	61	201446		CHIOTTI, P	62	601237	

BIB	TH N						
COMSTOCK, M		60	600623				
CPH	TH3N 4						
SATO, S		39	900114				
DM	TH3N 4						
NEUMANN, B KROGER		32	900113				
MPP	TH NITRIDES						
SKINNER, G BECKETT		60	601226				
DF	TH O						
ACKERMANN, R THORN		58	601610				
PHAS	TH O						
KORNILOV, I		60	200769				
SPK	TH O						
ROSEN, B		62	301660				
THER	TH O						
SCHICK, H ANTHROP		62	300996				
THER	TH O						
ACKERMANN, R THORN		58	601087				
VAP	TH O						
ACKERMANN, R THORN		58	601610				
THER	TH O 2						
ACKERMAN, E. RAUH		63	301164				
CPH	TH O 2						
HOCH, M JOHNSTON		61	201171				
CPH	GH O 2						
HOCH, M JOHNSTON,		61	700666				
REAC	TH O 2						
KOMAREK, K COUCOUL		63	301269				
TRT	TH O 2						
MUMPTON, F ROY, R		60	301308				
CPL	TH O 2						
OSBORNE, D WESTRUM		53	600968				
CRYS	TH O 2						
DRAPER, A MILLIGAN		59	201104				
CRYS	TH O 2						
VAN ARKEL, A		24	701066				
CRYS	TH O 2						
VOGEL, R KEMPTER		59	601177				
CTEX	TH O 2						
SKINNER, B		57	601066				
CTEX	TH O 2						
GRAIN, C CAMPBELL		61	601471				
CTEX	TH O 2						
KEMPTER, C ELLIOTT		59	601160				
DF	TH O 2						
ACKERMANN, R THORN		58	601610				
DM	TH O 2						
VON WARTENBERG, H		09	900108				
DM	TH O 2						
CHAUVENET, E		11	900109				
ELCH	TH O 2						
DANFORTH, W		57	601317				
ERES	TH O 2						
VAN ARKEL, A FLOOD		53	600960				
MSP	TH O 2						
HASAPIS, A MELVEGE		61	701017				
MPP	TH O 2						
NAGASAWA, S		50	400630				
PHAS	TH O 2						
GRAIN, C CAMPBELL		61	601471				
PHAS	TH O 2						
RUFF, O EBERT, F		29	900120				
SPK	TH O 2						
COFFMAN, J KIBLER		60	700993				
SURF	TH O 2						
DRAPER, A MILLIGAN		59	201104				
TCON	TH O 2						
ADAMS, M		54	600961				
TCON	TH O 2						
NORTON, H KINGERY		52	601240				
TCON	TH O 2						
WOCHMAN, J		62	601472				
TCON	TH O 2						
KINGERY, W FRANCL		54	600971				
THER	TH O 2						
COFFMAN, J KIBLER		60	700993				
THER	TH O 2						
ACKERMANN, R THORN		58	601087				
THER	TH M2						
VICTOR, A DOUGLAS		61	201108				
THER	TH O 2						
INGHRAM, M CHUPKA		57	601087				
THER	TH O 2						
KUBASCHEWSKI, O		61	600792				
THER	TH O 2						
ZAREMBO, Y		61	201449				
TRT	TH O 2						
RUFF, O EBERT, F		29	900120				
VAP	TH O 2						
SHAPIRO, E		52	100186				
VAP	TH O 2						
COFFMAN, J KIBLER		60	700993				
VAP	TH O 2						
ACKERMANN, R THORN		58	600983				
VAP	TH O 2						
DARNELL, A		61	201182				
VAP	TH O 2						
ACKERMANN, R THORN		58	601610				
VAP	TH O 2						
ACKERMANN, R		56	601267				
VAP	TH O 2						
HASAPIS, A PANISH		60	600667				
VAP	TH O 2						
HOCH, M JOHNSTON		54	600972				
CRYS	TH OXIDES						
FRIED, S		56	601021				
BIB	TH O SYST						
COMSTOCK, M		60	600623				
PHAS	TH O SYST						
WESTRUM, E GRONVOL		62	601613				
THER	TH O SYST						
WESTRUM, E GRONVOL		62	601613				
THER	TH O SYST						
ACKERMANN, R THORN		62	601616				
VAP	TH O SYST						
WESTRUM, E GRONVOL		62	601613				
VAP	TH O SYST						
ACKERMANN, R THORN		62	601616				
REAC	TH O AL SYST						
RALEIGH, D		62	201698				
PHAS	TH RH						
FERRO, R RAMBALDI		61	201696				
REAC	TH U						
ENGLE, G GOEDDEL		62	201626				
PHAS	TH U B SYST						
TOTH, L NOWOTHNY		61	201406				
PHAS	TH U C SYST						
IVANOV, O ALEKSEEV		61	201876				
THEO	TH U C SYST						
BENESOVSKY, F RUDY		61	900203				
PHAS	TH V						
PALMER, P MCMASTER		62	201791				
PHAS	TH W C						
RUDY, E BENESOVSKY		62	201628				
CRYS	TH Y SYST						
EVANS, D RAYNOR, G		60	200874				
PHAS	TH ZN SYST						
CHIOTTI, P GILL, K		61	700624				
THER	TH ZN SYST						
CHIOTTI, P GILL, K		61	700624				
PHAS	TH ZR						
BADAEVA, T ALEKSE		61	201892				
PHAS	TH ZR C SYST						
BODAEVA, T KUZNETS		63	202006				
PHAS	TH ZR C SYST						
RUDY, E BENESOVSKY		62	300969				
PHAS	TH ZR V SYST						
BADAEVA, T ALEKSEE		61	201893				
CPH	THEORY						
FOMICHEV, E KANDYB		62	300886				
DF	THEORY						
MAZO, R		63	202100				
CPH	THEORY						
LIDENKO, V YARYSHE		63	301136				
CPH	THEORY						
DIDENKO, V YARYSHE		62	300878				

CPH	THEORY						
CHAMBERS, R		62	300819				
CPL	THEORY						
FOREMAN, A		62	301083				
CPL	THEORY						
RELLER, J WALLACE		62	301092				
CPL	THEORY						
MARADNDIN, A FLINN		61	301085				
CPL	THEORY						
MARADNDIN, A FLINN		61	301084				
CRYS	THEORY						
KAU, R		61	201198				
DH	THEORY						
WILCOX, D		62	301011				
DH	THEORY						
REZNITSKII, L		61	300348				
DHD	THEORY						
VERHAEGEN, G STAFFO		62	301060				
H	THEORY						
FOMICHEV, E KANDYB		62	300885				
MISC	THEORY						
SAMSONOV, G KOVALC		62	301154				
MSP	THEORY						
GOROKHOV, I		62	300895				
PHAS	THEORY						
JONES, G		63	301490				
PHAS	THEORY						
BOROVSKII, I MARCH		60	201014				
VAP	THEORY						
ICZKOWSKI, R MARGR		63	300905				
VAP	THEORY						
GREGORY, N		63	300892				
VAP	THEORY						
MARTYNKEVICH, G		61	300554				
ZKP	THEORY						
WREDERKEHR, R		62	301056				
BIB	THERMODYNAMICS						
LATIMER, W		54	601635				
PHAS	THERMODYNAMICS						
RUDY, E		62	900228				
REAC	THERMODYNAMICS						
WAHLBECK, P EDWARD		61	301163				
REV	THERMODYNAMICS						
BAZAROV, I		62	301185				
REV	THERMODYNAMICS						
WELLS, P		63	301618				
REV	THERMODYNAMICS						
SKINNER, H WADDING		63	301589				
THEO	THERMODYNAMICS						
RUDY, E		63	301565				
THEO	THERMODYNAMICS						
ANTHONY, R HIMMELB		63	301398				
THEO	THERMODYNAMICS						
MASLOV, P MASLOV		61	300658				
THEO	THERMODYNAMICS						
STORONKIN, A SHULI		60	300296				
THEO	THERMODYNAMICS						
BAZAROV, I		61	300389				
THEO	THERMODYNAMICS						
MAYER, J		62	300397				
THEO	THERMODYNAMICS						
PRILEZHAeva, N		60	301153				
THEO	THERMODYNAMICS						
MEIXNER, J		60	200824				
VAP	THERMODYNAMICS						
BLANC, B		61	201346				
BETA	TI						
KRUPNIKOU, K BAKAN		63	301149				
BIB	TI						
WOHL, M		60	700723				
CPH	TI						
FIELDHOUSE, I LANG		60	601583				
CPH	TI						
SEREBRENNIKOV, N N		61	300192				
CPL	TI						
CLUSIUS, K FRANZOS		58	200927				
CPL	TI						
STALINSKI, B BIEGA		61	201045				
CPL	TI						
STARKE, E CHENG, C		62	201730				
CRYS	TI						
ANDERSON, S		60	200845				
CRYS	TI						
SADOVSKII, V BOGAC		60	600863				
CRYS	TI						
SOREL, M			600787				
CRYS	TI						
JAMIESON, J		63	301263				
CPL	TI						
KNIEF, G BETTERTON		63	301264				
CRYS	TI						
WOOD, R		62	201956				
CTEX	TI						
FIELDHOUSE, I LANG		60	601583				
CTEX	TI						
BESSERER, C		58	700929				
CTEX	TI						
NOWOTNY, H LAUBE		61	600844				
CTEX	TI						
WILLIAMS, D		61	600782				
CTEX	TI						
WASILEWSKI, R		61	201342				
DH	TI						
GOLDSMITH, A HIRSC		60	700930				
DHT	TI						
HERTZRICKEN, S SLY		62	300708				
ERES	TI						
BRIDGMAN, P		61	400533				
ERES	TI						
BERLINCOURT, T		59	601655				
ERES	TI						
POWELL, R W TYE, R		61	700652				
ERES	TI						
WASILEWSKI, R		62	201515				
KIN	TI						
KONSTAD, P ANDERSON		61	700531				
KIN	TI						
ARZHANYI, P VOLKOV		62	201975				
MISC	TI						
SPINK, D		61	200891				
CPH	TI						
HOLLAND, M		63	202054				
MPP	TI						
KAREV, V KLYUCHARE		63	202064				
ERES	TI						
KORNILOV, I MIKHEE		63	202079				
CRYS	TI						
NIKIFOROV, I SACHE		63	202109				
CPL	TI						
SHIMI, M TAKAHAS		63	202135				
REV	TI						
SHVARTS, G SAVEIKI		63	202136				
MISC	GI						
WADsLEY, A		61	201100				
MISC	TI						
BASKIN, M TRETYAKO		62	201951				
MPP	TI						
BESSERER, C		58	700929				
MPP	TI						
SKINNER, G BECKETT		50	601225				
PHAS	TI						
KORNILOV, I		60	200907				
PHAS	TI						
GOLDSMITH, A HIRSC		60	700930				
PHAS	TI						
WORNER, H		60	200991				
PHAS	TI						
SOREL, M			600787				
PHAS	TI						
NISHIMURA, H HIRAM		57	201397				
PHAS	TI						
BLOK, N GLAZOVA, N		61	201490				
PHAS	TI						
KUSAMICHI, H KUSAM		57	201494				
PHAS	TI						
WYDER, W HOCH, M		62	201581				

SAVITSKII, E LIVAN	61	201889	KIN	TI B 2		
PHAS	TI		RAKOVSKII, V		62	301328
SEMENCHENKOV, A	61	201894	REAC	TI B 2		
REAC	TI		FUNKE, V YUDKOVSKI		63	202034
BIRYUKOVA, L SAKSO	60	200851	MPP	TI B 2		
REAC	TI		MALYUCHKOV, O POVI		62	202085
LAINER, D TSYPIN	61	201134	CRYS	TI B 2		
REAC	TI		EHRlich, P GUTSCHE		61	201331
KOFSTAD, P ANDERSON	61	201096	CTEX	TI B 2		
REAC	TI		GILMAN, J ROBERTS		61	300300
OGURTSOV, S	60	200967	DF	TI B 2		
REAC	TI		KRESTOVNIKOV, A VE		60	300672
STRINGER, J	60	700559	DH	TI B 2		
REAC	TI		LOWRIE, R		61	700956
ANITOVA, I S GARBA	61	700603	DH	TI B 2		
REAC	TI		LOWELL, C WILLIAMS		61	300410
CERVONE, E FURLANI	61	201521	DH	TI B 2		
REAC	TI		EPELBAUM, V A STAR		55	300194
ANDREEVA, V ALEKSE	62	201814	DH	TI B 2		
REV	TI		WILLIAMS, W		61	300523
WOHL, M	60	701053	DHT	TI B 2		
REV	TI		LOWRIE, R		61	700956
EREMENKO, U	60	300286	H	TI B 2		
REV	TI		MEZAKI, R TILLEUX		62	601617
BOMBERGER, H	62	300369	MPP	TI B 2		
SPK	TI		PORTNOY, K SAMSONO		61	300485
ZHURAKOVSKII, E VA	59	201226	MPP	TI B 2		
SPK	TI		SHCHERBAKOV, V VEY		60	300984
ROSENZWEIG, N PORT	60	700996	MPP	TI B 2		
SPK	TI		BLUM, A WIELCZKO		61	300491
ROSENZWEIG, N PORT	60	700901	MSP	TI B 2		
SPK	TI		LOWRIE, R		61	700956
SWEENEY, W SEAL, R	61	201112	MSP	TI B 2		
SPK	TI		LOWRIE, R		60	701014
WILSON, C THEKA EKA	61	201001	PHAS	TI B 2		
SPK	TI		FORELIK, C YELYUTI		62	300884
SHAW, C	55	600908	PHAS	TI B 2		
SPK	TI		LEITNAKER, J KRIKO		62	300408
BLOKHIN, M SHUVAEV	62	201778	REAC	TI B 2		
SPK	TI		LEITNAKER, J KRIKO		62	300408
BOLOTIN, G VOLOSHI	62	201830	REAC	TI B 2		
TCO	TI		LAVENDEL, H		61	300482
FIELDHOUSE, I LANG	60	601583	REAC	TI B 2		
TCO	TI		KUBO, T HANAZAWA		60	201428
LOWRIE, R	61	700943	S	TI B 2		
TCO	TI		MEZAKI, R TILLEUX		62	601617
BESSERER, C	58	700929	THE	TI B 2		
TCO	TI		BOLGAR, A		61	700938
POWELL, R W TYE, R	61	700652	THE	TI B 2		
TCO	TI		MEERSON, G		60	300298
KUPROVSKII, B GELD	61	201867	VAP	TI B 2		
THEO	TI		BOLGAR, A		61	700938
ROSENZWEIG, N PORT	60	700996	VAP	TI B 2		
TRT	TI		LOWRIE, R		61	700956
BOKSHTAIN, S GUBAR	62	301408	VAP	TI B 2		
TRT	TI		LOWRIE, R		60	701014
JAYARAMAN, A KLEME	63	301482	VAP	TI B 2		
VAP	TI		SCHICK, H ANTHROP		63	300994
SCHRAM, A	60	301583	VAP	TI B 2		
VAP	TI		KIBLER, G LYON, T		61	300409
FRANZEN, J HINTENB	61	700970	REAC	TI BORIDES		
VAP	TI		SAMSONOV, G		59	600120
HANLIN, H	60	700951	MSP	TI B SYST		
VAP	TI		SEARCY, A WILLIAMS		60	300590
GOLDSMITH, A HIRSC	60	700930	VAP	TI B SYST		
KIN	TI SYST		SCHISSEL, P TRULSO		62	300606
KUBASCHEWSKI, O	62	601577	PHAS	TI B C SYST		
THE	TI SYST		NOWOTNY, H		61	201170
KUBASCHEWSKI, O	62	601577	REAC	TI B C SYST		
CPH	TI B 2		SAMSONOV, G		60	300273
KRESTOVNIKOV, A VE	60	300672	MISC	TI B N		
VAP	TI B 2		FORNEY, G J MARSHA		61	300238
FESSENKO, V BOLGAR	63	301216	PHAS	TI B N SYST		
CRYS	TI B 2		NOWOTNY, H		61	201170
GORELIK, C ELYUTIN	62	301230	SPK	TI BE		
THE	TI B 2		VAINSHTEIN, E BLOK		62	201585
MIKSIC, M	63	301303	PHAS	TI BE SYST		
			VAINSHTEIN, E		61	201163

TI BR				TI C			
THER	FUNAKI, K UCHIMURA	61	201609	S	KAUFMAN, L	62	300910
CEMP	TI C			KIN	TI C		
DF	BONDARENKO, B ERMA	62	301409	KIN	KIRILLOVA, G MEERS	60	200759
VIDALE, G	TI C	61	301610	LOWELL, C WILLIAMS	61	300410	
DHD	TI C			MARTIN, R SEAGLE	61	300308	
BITTNER, H GORETZK	62	301132		MARTIN, R SEAGLE	61	300308	
CRYB	TI C			MOROZOVA, M KHRIPU	62	300597	
GORELIK, C ELYUTIN	62	301230		NEEL, D PEARS, C	61	300146	
TCON	TI C			REAC	TI C		
HOCH, M VARDI, J	63	301245		NIKOLAISKI, E	60	300130	
CEMP	TI C			NOGUCHI, S SATE, T	60	300227	
INGOLD, J	63	301251		NORTON, J MOWRY, A	49	300157	
DH	TI C			NORTON, J	60	701001	
KHRIPUN, M MARIYA	62	301258		OGAWA, K BRANDO, Y	59	201332	
CTEX	TI C			CRYB	TI C		
KRIKORIAN, WALLA	63	301285		RAMAN, S RAMACHAND	62	300551	
CRYB	TI O			MPP	TI C		
HOCH, M	63	202053		SUGIYAMA, M SUZUKI	61	300331	
CRYB	TI C			TCON	TI C		
ASHBEE, K EELES, W	62	201994		TAYLOR R	61	201288	
CEMP	TI C			CRYB	TI C		
BITTNER, H GORETZK	62	202004		VAN ARKEL, A	24	701056	
MPP	TI C			MEERSON, G	60	300298	
AGTE, C BLUM, G	61	300342		REAC	TI CARBIDES		
REAC	TI C			MEERSON, G ZELIKMA	61	201912	
SAMSONOV, G		301571		MPP	TI C SYST		
TCON	TI C			BASKIN, M TRETYAKO	61	300856	
HOCH, M VARDI, J	63	301476		PHAS	TI C SYST		
VAP	TI C			BICKERDIKE, R L HU	59	300156	
VIDALE, G	61	301611		MPP	TI C SYST		
VAP	TI C			BURYLEV, B	61	301071	
ANON	60	600666		THIR	TI C SYST		
PHAS	TI C			CUNNINGHAM, G WARD	63	301208	
ARAI ZENZABURO HA	60	200773		PHAS	TI C SYST		
THIR	TI			EDWARDS, R RAINE	52	300288	
BOLGAR, A	61	700938		PHAS	TI C SYST		
VAP	TI C			KURMAKOV, N TRONEV	61	601588	
BOLGAR, A	61	700938		PHAS	TI C SYST		
COPT	TI C			MAYRUT, D OGDEN	60	700983	
BRESKER, R VORONIN	59	300799		REAC	TI C SYST		
COPT	TI C			PORTNOI, K LEVINSK	61	300215	
COFFMAN, J COULSON	61	701040		PHAS	TI C CO SYST		
CRYB	TI C			EREMENKO, U LESNIK	56	300285	
COFFMAN, J COULSON	61	701040		PHAS	TI C MO SYST		
DF	TI C			EREMENKO, V VELIKA	61	201278	
COFFMAN, J COULSON	61	701040		PHAS	TI C NB SYST		
PHAS	TI C			YELYNTIN, V BERNST	55	300283	
COFFMAN, J COULSON	61	701040		MPP	TI C NI SYST		
VAP	TI C			KORNILOV, N PRYAKH	60	300209	
COFFMAN, J COULSON	61	701040		PHAS	TI C NI SYST		
DF	TI C			EREMENKO, V N KOSO	59	300212	
COFFMAN, J COULSON	61	300293		CEMP	TI C N SYST		
REAC	TI C			LVOV, S NEMCHENKO	62	201873	
EREMENKO, V VELIKA	59	201279		PHAS	TI C W SYST		
PHAS	TI C			KREIMER, G VAKHOVS	59	300213	
FORELIK, C YELYUTI	62	300884		REAC	TI CL		
DH	TI C			GOPIENKO, V	60	200913	
FUJISHIRO, S GOKCE	61	701012		THIR	TI CL3		
THIR	TI C			CLIFTON, D MACWOOD	56	300292	
FUJISHIRO, S GOKCE	61	701012		TRT	TI CL3		
VAP	TI C			OGAWA, S	60	200764	
FUJISHIRO, S GOKCE	61	701012		VAP	TI CL3		
CTEX	TI C			SANDERSON, B MACWO	56	300291	
GILMAN, J ROBERTS	61	300300		REAC	TI CL4		
PHAS	TI C			KRIEVE, W MASON, D	56	300290	
GORBUNOV, N ET AL	61	300382					
REAC	TI C						
GRIGOREVA, V SERED	61	300398					
COPT	TI C						
HODDAD, R E GOLDWA	49	300160					
REAC	TI C						
HOLDEN, F A KINGER	55	300161					
CEMP	TI C						
HOLLANDER, L E JR	61	700528					
ERES	TI C						
HOLLANDER, L E JR	61	700528					

S	TI CL4			CRY	TI N		
MUNSTER, A RICH, G		58	300320	PEARSON, W		62	301029
TI CL4				SPK	TI N		
KRESTOVNIKOV, A VE		59	200783	PHILIPP, W		62	300521
TI CL4				CEMP	TI N		
NIEDERKORN, I		60	201771	SAMSONOV, G VERKHO		62	300731
TI CL4				MPP	TI N		
MUNSTER, A RICH, G		58	300320	SAMSONOV, G VERKHO		61	300203
TI CR B SYST				MPP	TI N		
MEYERSON, G		59	301115	SAMSONOV, G VERKHO		61	201264
TI CR SYST				MPP	TI N		
GOLUBTSOVA, R		61	201150	SAMSONOV, G VERKHO		62	300997
TI CR SYST				REAC	TI N		
ERMANIS, F FARRER		61	201240	FEDOSEEV, V NEMKOV		62	201757
TI F 4				CEMP	TI N		
EULER, R WESTRUM		61	201157	SAMSONOV, G FOMENK		63	202128
TI F 1				TRT	TI N		
GREENBERG, E SETTL		62	300739	SAMSONOV, G FOMENK		63	202128
TI FE O SYST				SPK	TI N		
WEBSTER, A H BRIGH		61	300164	PARKINSON, W		63	202115
TI HALIDES				CRY	TI N		
KING, E WELLER, W		61	300735	VAN ARKEL, A		24	701058
TI H SYST				CEMP	TI NTRIDES		
LIVANOV, V BUKHANO		61	300386	SAMSONOV, G		60	700947
TI I				DH	TI NTRIDES		
FUNAKI, K UCHIMURE		61	201688	SAMSONOV, G		60	700947
TI IR				REV	TI NTRIDES		
CROENI, J ARMANTRO		62	201972	SAMSONOV, G		60	700947
TI MN				CRY	TI N SYST		
WATERSTRAT, R DAS		62	201702	HOLMBERG, B		62	300594
TI MO SYST				PHAS	TI N SYST		
HAKE, R		61	201456	MAYRUTH, D OGDEN,		60	700983
TI MO SYST				MPP	TI N SYST		
DUPOUY, J AVERBACH		61	201180	HARVEY, J KAUFMANN		59	600640
TI MO SYST				ERES	TI N SYST		
KORNILOV, I POLYAK		61	201242	WASILEWSKI, R		62	301076
TI MO SYST				PHAS	TI NB SYST		
KUZMIN, A PALATNIK		62	300922	SHAKHOVA, K BUDBER		61	201234
TI N				PHAS	TI NB CR SYST		
SAMSONOV, G VERKHO		61	301573	SHAKHOVA, K BUDBER		62	300993
TI N				PHAS	TI NB V SYST		
SCHAEFER, H FUHR		62	301578	KORNILOV, I VLASOV		57	500126
TI N				PHAS	TI NB ZR SYST		
ORBACH, H		62	301547	MIKHEEV, V BELOUSO		61	300834
TI N				CRY	TI NI SYST		
GOWARD, G HERSHENS		63	202042	BARTON, J PURDY, G		60	300210
TI N				PHAS	TI NI SYST		
FESENKO, V BOLGAR		63	301216	POOLE, D M HUME, W		55	300208
TI N				PHAS	TI NI SYST		
AKISHIN, P KHODEEV		62	300692	HARTON, J PURDY, G		60	300210
TI N				PHAS	TI NI SYST		
ARAI ZENZABURO HA		60	200773	PURDY, G PARR, J		61	300279
TI N				CRY	TI O		
BAUGHAN, E		59	300866	HOCH, M		63	301477
TI N				CRY	TI O		
BOLGAR, A		61	700938	POPOV, YU		62	301321
TI N				CRY	TI O		
BOLGAR, A		61	700938	ANDERSON, S		60	200845
TI N				SPK	TI O		
DOUGLASS, D ST PIE		61	201341	BERG, R A SINANOGL		60	300177
TI N				ERES	TI O		
DREGER, L MARGRAVE		60	700991	SAMOKHVALOV, A RUS		63	301567
TI N				ERES	TI O		
DREGER, L		62	300720	MCLAREN, G		62	301534
TI N				ERES	TI O		
DREGER, L		61	300628	YAMASHITA, J		63	301625
TI N				SPK	TI O		

PHAS	TI O			CRY5	TI O 2		
BREWER, L MASTIK		49	601634	RAO, C		61	700549
PHAS	TI O			CRY5	TI O 2		
TROJER, F		62	201929	BAUR, W H		61	700555
PHAS	TI O			CTEX	TI O 2		
PETTERSON, A LINDG		62	301162	GRAIN, C CAMPBELL		61	601471
CRY5	TI O			ELCH	TI O 2		
CODLING, K		61	600775	SMIRNOV, M PALGNEV		60	300297
SPK	TI O			ERES	TI O 2		
FRASER, P A JERMAI		54	300145	GREENER, E WHITMOR		61	300487
DF	TI O			KIN	TI O 2		
HOCH, M		60	300311	MOROZOV, I STEFANY		58	200796
S	TI O			KIN	TI O 2		
HOCH, M IYER, A		62	300897	KENNEDY, D R RITCH		58	300225
S	TI O			KIN	TI O 2		
KAUFMAN, L		62	300910	SUZUKI, A KOTENA		62	201838
SPK	TI O			PHAS	TI O 2		
KIESS, C		48	600685	BRAUER, J LITCKE		60	201990
PHAS	TI O			PHAS	TI O 2		
KORNILOV, I		60	200769	DELIMARSKY, Y BUDE		62	300880
DH	TI O			PHAS	TI O 2		
KRESTOVNIKOV, A		62	300930	KNOLL, H		63	301266
TCON	TI O			REAC	TI O 2		
KURYLENKO, C		58	201565	KOMAREK, K COU COUL		63	301269
MPP	TI O			CPL	TI O 2		
LECERF, A		62	300939	MATOSSE, F		63	301299
REAC	TI O			MPP	TI O 2		
MAKAROV, E KUZNETS		60	600772	BAUR, W H		61	700554
SPK	TI O			PHAS	TI O 2		
ORTENBURG, F		60	600917	GRAIN, C CAMPBELL		61	601471
SPK	TI O			PHAS	TI O 2		
ORTENBERG, F		61	300821	STRAUMANIS, M EJIM		61	201078
SPK	TI O			PHAS	TI O 2		
PAPOUSEK, D		61	700675	HIDA, Y OZAKI, S		61	700519
THER	TI O			PHAS	TI O 2		
PAPOUSEK, I		61	700675	RAO, C YOGANARASMH		61	700535
SPK	TI O			PHAS	TI O 2		
PARKINSON, W NICHOL		59	600612	COCCO, A VIRDIS, P		61	201316
SPK	TI O			PHAS	TI O 2		
PETTERSSON, A LIND		61	700544	MASSAZZA, F		61	201293
SPK	TI O			REAC	TI O 2		
PETTERSSON, A V LI		61	700605	MELENTEV, B		60	200964
SPK	TI O			REAC	TI O 2		
PHILLIPS, J G		54	300165	KUTSEV, V S ORMONT		55	300153
SPK	TI O			REAC	TI O 2		
PHILLIPS, J		50	600890	GEHARDT, J HERRIN		58	300217
SPK	TI O			REAC	TI O 2		
PHILLIPS, J		51	600891	MEERSON, G		62	300950
ERES	TI O			REV	TI O 2		
WASILEWSKI, R		62	201516	PETER, A		62	201523
CRY5	TI O			REAC	TI O 2		
STRAUMANIS, M LI		60	200780	CZANDEANS, A W HOM		59	300224
CEMP	TI O 2			MPP	TI O 2		
GREENER, E WHITMOR		61	600862	MCTAGGART, F		63	202101
CRY5	TI O 2			MPP	TI O 2		
KOFSTAD, P		62	301507	NAGARJAN, G		63	202106
CRY5	TI O 2			REV	TI O 2		
ASHBEE, K EELES, W		62	201994	GRANT, F		59	300890
PHAS	TI O 2			SPK	TI O 2		
DACHILLE, F ROY, R		62	202022	PRASAD, S		62	301553
PHAS	TI O 2			SPK	TI O 2		
DIAMOND, J SCHNEID		60	202028	SOFFER, B		61	201327
CEMP	TI O 2			THER	TI O 2		
ACKET, G VOLGAR, J		63	301165	KUBASCHIEWSKI, O		61	600792
CPH	TI O 2			THER	TI O 2		
JOSHI, S MITRA, S		60	200767	SCHICK, H ANTHROP		63	301579
CPL	TI O 2			THER	TI O 2		
JOSHI, S MITRA, S		60	200767	SCHICK, H ANTHROP		63	301580
CRY5	TI O 2			TRT	TI O 2		
YOGANARASIMHAN, S		61	200881	RUDNEVA, A MODEL		63	301564
CRY5	TI O 2			TRT	TI O 2		
ANDERSON, S		60	200845	BRAUER, J LITCKE		60	201990
CRY5	TI O 2			TRT	TI O 2		
STRAUMANIS, M EJIM		61	201078	RAO, C YOGANARASMH		61	700535
CRY5	TI O 2			TRT	TI O 2		
VON WERNER, H BAUR		55	300181	RAO, C		61	700549
CRY5	TI O 2			ZKP	TI O 2		
RAO, C YOGANARASMH		61	700535	KUTSEV, V S ORMONT		55	300153

PHAS	TI2O 3	60	200777	REAC	TI O C SYST		
TRT	TI2O 3			NISHIMURA, H KIMUR		54	300169
BRAUER, J LITTKER		60	200777	PHAS	TI RE		
MPP	TI2O 3			AGEEV, N KARPINSKI		61	201762
LECERF, A		62	300939	PHAS	TI SC SYST		
CRY5	TI2O 3			SAVITSKII, E BURKH		61	700622
STRAUMANIS, M EJIM		62	300692	DH	TI SI SYST		
ERES	TI2O 3			GOLUTVIN, Y		56	400599
YAHIA, J FREDERIKS		61	300490	DH	TI SI SYST		
CRY5	TI2O 3			GOLUTVIN, Y		62	301229
ABRAHAMS, S		63	201991	PHAS	TI SI SYST		
E	TI2O 3			GOLUBTSOVA, R B		61	300174
ARIYA, S SOBOLEVA		61	300787	PHAS	TI SI O SYST		
PHAS	TI3O			COCCO, A SCHROMEK		60	201188
KORNILOV, I GLAZOV		63	202081	CPL	TI V SYST		
CRY5	TI3O 5			CHENG, C GUPTA, K		62	300760
ASBRINK, S MAGNELI		59	700522	PHAS	TI V SYST		
CRY5	TI5O 9			ERMANIS, F FARRER		61	201240
ANDERSSON, S		60	201381	PHAS	TI V SYST		
PHAS	TI6O			KORNILOV, I POLYAK		61	201242
KORNILOV, I GLAZOV		63	202081	MPP	TI W B SYST		
BIS	TI OXIDES			MEYERSON, G		59	301116
CHAPMAN, M		60	701006	CRY5	TI W C SYST		
CRY5	TI OXIDES			FUNKE, V PANOV, V		61	201236
MAGNELI, A ANDERSON		61	201566	MPP	TI W C SYST		
KIN	TI OXIDES			FUNKE, V PANOV, V		61	201236
DOUGLASS, D ST PIE		61	201341	PHAS	TI W C SYST		
PHAS	TI OXIDES			FUNKE, V PANOV, V		61	201236
ANDERSSON, S		59	201178	PHAS	TI Y SYST		
VAP	TI O SYST			BARE, D		61	201146
FRANZEN, H		63	202033	PHAS	TI ZR SYST		
THEO	TI O SYST			ENCE, E MARGOLIN		61	200919
GELD, P TSKHAI, V		63	202036	PHAS	TI ZR SYST		
THER	TI O SYST			ENCE, E MARGOLIN		61	300162
VEINBACHS, A KOMAR		62	601611	PHAS	TI ZR SYST		
ERES	TI O SYST			GRIDNEV, V TREFILO		60	201093
WASILEWSKI, R		62	301076	PHAS	TI ZR O SYST		
PHAS	TI O SYST			HOCH, M		59	201136
MAYRUTH, D OGDEN		60	700983	REAC	TI ZR O SYST		
CEMP	TI O SYST			RUH, R		63	202124
VASILEV, Y KHRYCH		63	301608	PHAS	TI ZR O SYST		
PH	TI O SYST			HOCH, M DEAN, R		61	300546
NOMURA, S KAWAKUBO		61	700638	THER	TI ZR O SYST		
PHAS	TI O SYST			HOCH, M DEAN, R L		59	300214
LIVANOV, V BUKHANO		61	300386	THER	TI ZR O SYST		
CRY5	TI O SYST			HOCH, M DEAN, R		61	300546
MAGNELI, A		60	600617	PHAS	TI ZR O SYST		
PHAS	TI O SYST			DOMAGALA, R			300302
KUBASCHEWSKI, O		62	601577	CRY5	TM		
THER	TI O SYST			KOEHLER, W WOLLAN		61	301504
KRESTOVNIKOV, A LO		60	300927	DH	TM		
CRY5	TI O SYST			SAVAGE, W HUDSON		59	601126
HOLMBERG, B		62	300596	ERES	TM		
REAC	TI O SYST			COLVIN, R LEGVOLD		60	601389
HURLEN, T		60	200890	SPK	TM		
CPH	TI O SYST			SAKELLARIDIS, P		53	100184
EROFEEVA, M LUKINY		61	700602	SPK	TM		
CRY5	TI O SYST			AKIMOV, A		57	601099
BRIGHT, N		61	300661	MERRILL, P GREENST		56	601007
CRY5	TI O SYST			VAP	TM		
BRIGHT, N		61	300661	ANON		56	601319
PHAS	TI O SYST			SPK	TM		
BLUMENTHAL, R WHIT		62	601666	BLAISE, J VETTER		63	202005
THER	TI O SYST			VAP	TM		
BLUMENTHAL, R WHIT		62	601666	SAVAGE, W HUDSON		59	601126
CRY5	TI O SYST			CEMP	TM B 6		
ARIYA, S POPOV, Y		62	300599	SAMSONOV, G PADERN		59	300143
VAP	TI O SYST			CPH	TM2O 3		
ANON		60	701016	PANKRATZ, L KING		63	202114
PHAS	TI O SYST			CPL	TRANSITION METALS		
ANON		60	701016	KAKUSHADZE, T		61	300818
CRY5	TI O 2 SYST			CPL	TRANSITION METALS		
VOTINOV, M DEMIDEN		62	301613	WOLCOTT, N		56	601137
REAC	TI O C			CRY5	TRANSITION METALS		
KUBO, T SHINRIKI		61	201691	DWIGHT, A		61	201200
PHAS	TI O C SYST			MISC	TRANSITION METALS		
NISHIMURA, H KIMUR		54	300169	WATT, G W		61	700590

REAC TRANSITION METALS
AGEEV, N KOPETSKII

59 201230

U

CRYS	U		
SUTTON, A EELES, W	62	301800	
PHAS	U		
KLEMENT, W JAYARAM	63	301502	
REAC	U		
BESSONOV, A VLASOV	62	301188	
BIB	U		
ANON	58	601368	
BIB	U		
CROXTON, F	51	600956	
BIB	U		
ALLEN, R	53	600965	
CEMP	U		
RAUCH, E	56	601261	
CEMP	U		
HOLDEN, A	58	601562	
CEMP	U		
KATZ, J	58	601533	
CEMP	U		
RIVIERE, J	62	201805	
CPH	U		
MITKINA, E	59	201029	
CPH	U		
MOORE, G KELLEY, K	47	601646	
CPH	U		
GINNINGS, D CORRUC	47	601647	
CPH	U		
MORTH, J	56	600984	
CPL	U		
FLOTOW, H LOHR, H	60	601334	
CPL	U		
JONES, W M GORDON	52	400555	
CPL	U		
SMITH, P WOLCOTT	55	601137	
CPL	U		
GOODMAN, B HILLAIR	60	201518	
CRYS	U		
LUKESH, J	49	601652	
CRYS	U		
THEWLIS, J STEEPLE	54	601650	
CRYS	U		
WILSON, A RUNDLE	49	601657	
CRYS	U		
COOPER, A	62	601464	
CRYS	U		
JACOB, C WARREN, B	37	601653	
CRYS	U		
TUCKER, C	49	601371	
CRYS	U		
WILSON, A RUNDLE	49	601360	
CRYS	U		
STURCKEN, E POST	60	200857	
CRYS	U		
DAWSON, J	52	100187	
CRYS	U		
CHIOTTI, P KLEPPER	58	601074	
CRYS	U		
TUCKER, C	50	601176	
CRYS	U		
THEWLIS, J	52	100202	
CRYS	U		
THEWLIS, J	51	400569	
CRYS	U		
TUCKER, W SENIO, P	56	601016	
CRYS	U		
TUCKER, C SENIO, P	53	600964	
CRYS	U		
TUCKER, C SENIO, P	52	601261	
CRYS	U		
TUCKER, T	52	600673	

CRYS	U		
TUCKER, C W	52	400570	
CRYS	U		
TUCKER, C W	52	400571	
CRYS	U		
BRIDGE, J	58	601656	
CRYS	U		
CASH, A HUGHES, E	61	201362	
CRYS	U		
DONOHUE, J	61	201351	
CRYS	U		
LANIESSE, J ENGLAN	60	201980	
CTEX	U		
GOODMAN, M	60	601331	
CTEX	U		
SCHUCH, A F LAQUER	52	400568	
CTEX	U		
LEHV, P LANGERON	55	601005	
CTEX	U		
LLOYD, L	59	601203	
DH	U		
HOLLEY, C HUBER, E	60	601178	
CTEX	U		
BRIDGE, J	56	601656	
DH	U		
HUBER, E V HOLLEY	52	400565	
DH	U		
MOORE, G KELLEY, K	47	601646	
ELCH	U		
SMIRNOV, M SKIBA	61	300992	
ERES	U		
HOVL, J	56	601303	
ERES	U		
TYLER, W WILSON, A	53	100185	
ERES	U		
BERLINCOURT, T	59	601655	
ERES	U		
MURK, K	59	601523	
ERES	U		
DAHL, A VAN DUSEN	47	601644	
MISC	U		
KATZ, J J RABINOWI	51	400578	
MPP	U		
HOLDEN, A	58	601562	
MPP	U		
KATZ, J	58	601533	
MPP	U		
WATSON, J WILDER	60	201321	
PHAS	U		
THEWLIS, J	52	100202	
PHAS	U		
BUTCHER, B	56	601031	
PHAS	U		
ANON	56	601302	
PHAS	U		
KURODA, T SUZUKI	58	601326	
PHAS	U		
BLUMENTHAL, B	60	601342	
PHAS	U		
MUELLER, M HITHERM	62	601431	
PHAS	U		
ALLENDORFER, A	50	400539	
PHAS	U		
TUCKER, C W	52	400570	
PHAS	U		
LEHR, P LANGERON	57	601058	
PHAS	U		
DAHL, A I CLEAVES	49	400580	
PHAS	U		
FISHER, E	61	201270	
PHAS	U		
JOHNSON, R	61	201253	
PHAS	U		
ANON	56	601419	
PHAS	U		
ANON	57	601507	
PHAS	U		
BAUMRUCKER, J CHIS	53	601651	

PHAS U				TCON U			
BUZZARD, R LISS, R	53	601649		WESTPHAL, R	55	601270	
PHAS U				TCON U			
CHRISTIAN, J	59	601621		ANON	57	601313	
PHAS U				TCON U			
FISHER, E	61	601455		FARIS, F	57	601310	
PHAS U				TCON U			
KLEPFER, H	57	601506		TYLER, W WILSON, A	53	100185	
PHAS U				TRT U			
SEMENCHENKOV, A	61	201894		AUBERT, H	62	201995	
REAC U				TCON U			
KATZ, J J RABINOWI	51	400578		SMITH, K	57	601063	
REAC U				TCON U			
DEUTSCH, N ERVIN	60	600123		ERIKSEN, V HALG, W	55	600934	
REAC U				TCON U			
BESSONOV, A VASLOV	61	201390		DAYTON, R	58	601525	
REAC U				THER U			
DERGE, G MARTIN, A	44	201526		FLOTOW, H LOHR, H	60	601334	
REV U				THER U			
KAUFMANN, A	62	601429		LEMMON, A WARD, J	52	601012	
REV U				THER U			
NICHOLS, R	57	601102		BREWER, L BROMLEY	47	400581	
REV U				THER U			
HANTOS, R	58	601075		SCHICK, H ANTHROP	63	301579	
REV U				THER U			
ANON	58	601539		MACWOOD, G	58	601143	
REV U				THER U			
ANON	58	601538		ACKERMANN, R THORN	62	601616	
REV U				THER U			
VETEJSKA, K	60	601199		MOORE, G KELLEY, K	47	601646	
REV U				THER U			
CHISWICK, H DWIGHT	58	601207		SKIDMORE, I MORRIS	62	601607	
SPK U				THER U			
ELYASHEVICH, M	53	601413		KENDALL, W	62	601684	
SPK U				TRT U			
MOROZOVA, N STARTS	57	601416		ALLENDORFER, A	50	400539	
SPK U				TRT U			
BOVEY, L ATHERTON	61	601422		DAHL, A ICLEAVES	49	400580	
SPK U				TRT U			
DIRINGER, M	60	601353		FISHER, E	61	201270	
SPK U				TRT U			
ATHERTON, N BOVEY	60	601327		ANON	57	601507	
SPK U				TRT U			
SCHUURMANS, P	46	601290		BURKE, J DIXON, P	62	301420	
SPK U				TRT U			
MCNALLY, J	52	100211		DAHLA VAN DUSEN	47	601644	
SPK U				VAP U			
MCNALLY, J	50	400523		RAUH, E THORN, R	54	600948	
SPK U				VAP U			
VAN DER BOSCH, J	49	400526		GILBREATH, J	52	601314	
SPK U				VAP U			
VANDEN BOSCH, J C	50	400554		GILBREATH, J	60	601333	
SPK U				VAP U			
SMITH, D D STOKENB	51	400564		GILBREATH, J	57	601300	
SPK U				VAP U			
STRIGANOV, A KOROA	55	600989		GILBREATH, J	55	601274	
SPK U				VAP U			
BEDREAG, O	54	601013		HANLIN, H	60	700951	
SPK U				VAP U			
OSARO, F PERLMAN	52	400572		DEISS, W	62	300877	
SPK U				VAP U			
SMITH, D	52	601249		RAUH, E THORN, R	54	601223	
SPK U				VAP U			
BURKHART, L STUKEN	49	601373		ACKERMANN, R RAUH	62	601685	
SPK U				VAP U			
BAKULINCE, I IONOV	59	601135		ACKERMANN, R THORN	62	601616	
SPK U				CEMP U B 2			
BOVEY, L WISE, H	59	601154		KLOPP, W	59	601542	
SPK U				CRYS U B 2			
ANON	58	601549		LUNSFORD, J FRIES	81	601466	
SPK U				CTEX U B 2			
ROGOSA, G SCHWARZ	53	500124		KLOPP, W	59	601542	
SPK U				CTEX U B 2			
NARBUTT, K LAPUTIN	62	201779		BECKMAN, G KIESSL	56	601049	
TCON U				PHAS U B 2			
MAKIN, B	54	601266		HOWLETT, B	51	601357	
TCON U				THER U B 2			
WEEKS, J	55	601282		KLOPP, W	59	601542	

CRYS	U B 4			PHAS	U C		
STEPANOVA, A ZHURA		58	601111	FERGUSON, I STREET		61	601418
CRYS	U B 4			PHAS	U C		
ZALKIN, A TEMPELTO		53	100198	NEWKIEK, H BATES		59	601165
CTEX	U B 4			REAC	U C		
STEPANOVA, A ZHURA		58	601111	FARR, J HUBER, E		59	601200
REV	U B 4			REAC	U C		
MATTERSON, K JONES		61	300324	CARTER, J H DAANE		61	400561
CRYS	U B 12			REAC	U C		
BERAUT, F BLUM, P		49	601363	PEAKALL, K ANTILL		62	601682
REAC	U B 12			REAC	U C		
PADERNO, Y		61	201276	GREGOIRE, P		62	201488
PHAS	U BORIDES			REV	U C		
BREWER, I SAWYER		50	601400	SEDDON, J		60	601380
DF	U B SYST			REV	U C		
ALCOCK, C GRIEVESO		62	601606	ROUGH, F CHUBB, W		60	600610
DH	U B SYST			MPP	U C		
ALCOCK, C GRIEVESO		62	601606	BROWN, D STOBO, J		62	301198
PHAS	U B SYST			CPL	U C		
HOWLETT, B		51	601357	COMBARIEN, A COSTA		63	301206
PHAS	U B SYST			THER	U C		
ANON		60	601328	GROSSMAN, L		63	301237
PHAS	U B SYST			TCON	U C		
ALCOCK, C GRIEVESO		62	601606	EDWARDS, R		52	601235
THER	U B SYST			THER	U C		
ALCOCK, C GRIEVESO		62	601606	FARR, J HUBER, E		59	601200
PHAS	U B C SYST			THER	U C		
TOTH, L		61	201256	WESTRUM, E		62	601689
PHAQ	U BE			THER	U C		
BADAIEVA, T KUZNETS		61	201833	KLOPP, W		59	601542
PHAS	U BE C SYST			TRT	U C		
BRISL, C ABBATTIST		61	201507	CHIOU, L P		52	601237
DH	U BR			TRT	U C		
SHCHUKAREV, S VASI		58	200847	NEWKIEK, H BATES		59	601165
SPK	U BR SYST			CRYS	U C 2		
PRGENT, J		60	200934	ATODA, T HIGASHI		61	301399
BIB	U C			PHAS	U C 2		
SEDDON, J		60	601380	BRIGGS, G GUHA, J		62	301416
CEMP	U C			DH	U C 2		
HOPKINS, B		62	300516	HUBER, E HEAD, E		63	202056
CEMP	U C			CEMP	U C 2		
KLOPP, W		59	601542	KLOPP, W		59	601542
CPH	U C			CPH	U C 2		
WESTRUM, E		62	601689	WESTRUM, E		62	601689
CRYS	U C			CRYS	U C 2		
WILLIAMS, J SAMBEL		60	601388	ATOJI, M MEDRU D, R		59	700867
CRYS	U C			CRYS	U C 2		
ATODA, I HIGASHI		61	301399	FERGUSON, I STREET		61	601418
CRYS	U C			CRYS	U C 2		
FERGUSON, I STREET		61	601418	BRED, M		60	700852
CRYS	U C			CRYS	U C 2		
CHIOTTL, P		52	601237	GILLAM, E		62	601680
CRYS	U C			CTEX	U C 2		
NOWOTNY, H		58	601079	KLOPP, W		59	601542
CRYS	U C			DF	U C 2		
CARTER, J H DAANE		51	400561	FUJISHIRO, S		61	601440
CRYS	U C			PHAS	U C 2		
VOGEL, R KEMPTER		59	601177	FERGUSON, I		61	201139
CTEX	U C			PREP	U C 2		
KLOPP, W		59	601542	TAKADA, Y IMOTTO		61	201937
DH	U C			THER	U C 2		
FARR, J HUBER, E		59	601200	FUJISHIRO, S		61	601440
ERES	U C			THER	U C 2		
GRIFFITHS, L		62	201569	WESTRUM, E		62	601689
PHAS	U C			THER	U C 2		
BRIGGS, G GUHA, J		62	301416	KLOPP, W		59	

MPP	U 2C 3				
	MALLET, M GERDS	51	100203		
BIB	U CARBIDES				
	JONES, P	60	201004		
CRYS	U CARBIDES				
	CHIOTTI, P	49	601416		
MPP	U CARBIDES				
	BARNES, E MUNRO, W	57	601036		
REAC	U CARBIDES				
	BARNES, E MUNRO, W	57	601036		
REAC	U CARBIDES				
	WILHELM, H CHIOTTI	49	400636		
THER	U CARBIDES				
	BREWER, L BROMLEY	47	400581		
TRT	U CARBIDES				
	CHIOTTI, P	49	601416		
SPK	U COMPOUNDS				
	DUNN, H	56	601024		
REAC	U COMPOUNDS				
	KATZ, S	62	201971		
SPK	U COMPOUNDS				
	EDING, H CARR, E	61	201061		
BIB	U C SYST				
	BOWMAN, F	60	601346		
BIB	U C SYST				
	COMSTOCK, M	60	600623		
CRYS	U C SYST				
	AUSTIN, A	59	601120		
CPH	U C SYST				
	MUKAIBO, T NAITO	62	601610		
CRYS	U C SYST				
	RUNDLE, R WILSON	58	601112		
DF	U C SYST				
	ALCOCK, C GRIEVES	62	601606		
OH	U C SYST				
	ALCOCK, C GRIEVES	62	601606		
MPP	U C SYST				
	CHUBB, W DICKERSON	62	601481		
PHAS	U C SYST				
	ANON	57	601298		
PHAS	U C SYST				
	ANON	53	601311		
CRYS	U C SYST				
	SHARMA, B	63	301194		
THER	U C SYST				
	CUNNINGHAM, G WARD	63	301208		
PHAS	U C SYST				
	ANON	57	601507		
PHAS	U C SYST				
	ANON	53	601513		
PHAS	U C SYST				
	ANON	57	601516		
PHAS	U C SYST				
	ANON	57	601555		
PHAS	U C SYST				
	ANON	57	601559		
PHAS	U C SYST				
	CHUBB, W PHILLIPS	61	601442		
PHAS	U C SYST				
	WILLIAMS, J SAMBEL	59	200872		
PHAS	U C SYST				
	ANON	59	601349		
PHAS	U C SYST				
	SILVERMAN, L	60	601364		
PHAS	U C SYST				
	ANON	60	601414		
PHAS	U C SYST				
	WILHELM, E	56	601264		
PHAS	U C SYST				
	RUNDLE, R WILSON	58	601112		
PHAS	U C SYST				
	WILSON, W	60	601193		
PHAS	U C SYST				
	MALLET, M GERDS	62	100188		
PHAS	U C SYST				
	BLUMENTHAL, B	56	601044		
PHAS	U C SYST				
	ALCOCK, C GRIEVES	62	601606		
PHAS	U C SYST				
	BLUMENTHAL, B	59	601692		
PHAS	U C SYST				
	EPREMIUM, E	57	601516		
REAC	U C SYST				
	SIVARTS, E	57	601109		
REAC	U C SYST				
	LOCK, L GAMBINO, J	56	601016		
REAC	U C SYST				
	CARTER, J H DAANE	50	400560		
THER	U C SYST				
	ANON	60	601414		
THER	U C SYST				
	BREWER, L BROMLEY	58	601146		
THER	U C SYST				
	ALCOCK, C GRIEVES	62	601606		
THER	U C SYST				
	HULLEY, C	63	601690		
MPP	U C O SYST				
	NAMBA, S IMOTA, S	61	400611		
REAC	U C O SYST				
	TRACHENKO, E VLASO	63	301606		
PHAS	U CE SYST				
	SAVITSKII, E BARON	62	201552		
SPK	U CL4				
	WING, R	61	201127		
SPK	U CL20 SYST				
	WING, R	61	201127		
REAC	U F				
	NGHI, N	61	201687		
REAC	U F				
	STEVENSON, J RUEHL	53	201727		
CPL	U F 4				
	BURNS, J OSBORNE	60	200848		
DH	U F 4				
	MALTSEV, V	60	201161		
PHAS	U F 4				
	KIRSHENBAUM, A	61	201183		
REAC	U F 4				
	CAVELL, R CLARK, H	62	201725		
SPK	U F 4				
	RAMBIDI, N AKISHIN	61	300763		
THER	U F 4				
	GALKIN, N	61	201248		
VAP	U F 4				
	AKISHIN, P KHODEEV	61	300453		
THER	U F 6				
	PARKS, B BARTON, D	60	200884		
REV	U F 6				
	TSUJIMURA, S	62	201985		
REAC	U F SYST				
	RESHETNIKOV, F GUR	62	300972		
DH	U FE SYST				
	AKHACHINSKIY, V KO	62	301104		
THER	U HALIDES				
	BREWER, L BROMLEY	47	400581		
THER	U HALIDES				
	MACWOOD, G	58	601143		
PHAS	U HF C SYST				
	RUDY, E BENESOVSKY	63	301333		
ERES	U MN				
	HAMAGUCHI, Y KUNIT	62	201568		
PHAS	U MO				
	KAWASAKI, M NAGASA	60	201491		
REAC	U MO				
	BELLOT, J DOSIER	58	201627		
PHAS	U MO SYST				
	TANGRI, K WILLIAMS	61	201308		
PHAS	U MO SYST				
	KRAMER, D RHODES	61	201367		
PHAS	U MO SYST				
	IVANOV, O BADAIEVA	61	201868		
PHAS	U MO SYST				
	IVANOV, O SEMENCHE	61	201896		
PHAS	U MO C				
	RUDY, E BENESOVSKY	63	301566		
PHAS	U MO C SYST				
	RUDY, E BENESOVSKY	63	301332		

PHAS	U MO C SYST				
FIZZOTTI, C SARAC		62	201697		
PHAS	U MO CR SYST				
BADAEVA, T KUZNETS		61	201899		
SPK	U MO X6				
HORTON, J THOMAS		62	201861		
PHAS	U MO ZR SYST				
IVANOV, O BAGROV		61	201840		
PHAS	U MO ZR SYST				
IVANOV, O BAGROV		61	201898		
BIB	U N				
COMSTOCK, M		60	600623		
BIB	U N				
KERR, W		62	601461		
CEMP	U N				
KLOPP, W		59	601542		
CRYS	U N				
KELLER, D		61	601446		
CRYS	U N				
CHIOTTI, P		62	601237		
CRYS	U N				
MUELLER, H KNOTT		58	601136		
CRYS	U N				
ANON		59	601550		
CTEX	U N				
KELLER, D		61	601446		
CTEX	U N				
KEMPTER, C ELLIOTT		59	601150		
CTEX	U N				
KLOPP, W		59	601542		
DH	U N				
GROSS, P HAYMAN, C		62	601621		
ERES	U N				
KELLER, D		61	601432		
PHAS	U N				
NEWKIEK, H BATES		59	601186		
PHAS	U N				
BRIGGS, G GUHA J		62	301416		
REAC	U N				
NEWTON, A S JOHNSO		51	400559		
REV	U N				
KERR, W		62	601461		
TCON	U N				
KELLER, D		61	601432		
TCON	U N				
EDWARDS, R		52	601236		
THER	U N				
KLOPP, W		59	601542		
TRT	U N				
OLSON, M MULFORD		63	301546		
TRT	U N				
CHIOTTI, P		52	601237		
TRT	U N				
NEWKIEK, H BATES		59	601186		
VAP	U N				
OLSON, M MULFORD		63	301546		
REAC	U N 2				
BESSONOV, A VLASOV		62	201942		
CRYS	U 2N 3				
EVANS, P		62	601463		
DH	U 2N 3				
GROSS, P HAYMAN, C		62	601621		
CRYS	U NITRIDES				
CHIOTTI, P		49	601177		
THER	U NITRIDES				
BREWER, L BROMLEY		47	400581		
TRT	U NITRIDES				
CHIOTTI, P		49	601177		
CRYS	U N SYST				
DAYTON, R		57	601509		
DH	U N SYST				
MOREAU, C PHILIPPO		61	201313		
MPP	U N SYST				
RUNDLE, R BAENZIGE		59	601140		
PHAS	U N SYST				
WILLIAMS, J SAMBEL		59	200872		
PHAS	U N SYST				
RUNDLE, R BAENZIGE		48	601376		
PHAS	U N SYST				
VAUGHAN, D		56	601004		
PHAS	U N SYST				
DAYTON, R		57	601509		
REAC	U N SYST				
RUNDLE, R BAENZIGE		59	601140		
SPK	U N SYST				
VAUGHAN, D		56	601004		
THER	U N SYST				
BREWER, L BROMLEY		58	601146		
PHAS	U N C SYST				
AUSTIN, A GERDS, A		58	601117		
PHAS	U NB				
NORTON, J OGILVIE		59	201811		
PHAS	U NB SYST				
IVANOV, O TEREKHOV		61	201946		
CEMP	U NB SYST				
BATES, L BARNARD		61	201202		
PHAS	U NB C SYST				
RUDY, E BENESOVSKY		63	301333		
PHAS	U NB MO SYST				
IVANOV, O TEREKHOV		61	201832		
PHAS	U NB MO SYST				
IVANOV, O TEREKHOV		61	201841		
PHAS	U NB MO SYST				
IVANOV, O TEREKHOV		61	201842		
CEMP	U O				
ZHUKOVSKII, V VASL		62	201982		
CRYS	U O				
YOUNG, W LYNDS, L		62	201567		
DF	U O				
MARKIN, T BONES, R		62	201819		
KIN	U O				
BESSONOV, A ALASOV		62	201964		
KIN	U O				
VOLPE, M MIHAILOVI		62	201919		
MSP	U O				
DEMAUA, G BURNS, R		60	601163		
PHAS	U O				
SUDO, K KIGOSHI, A		61	201530		
PHAS	U O				
ALEXANDER, C		62	201921		
PHAS	U O				
RUEDORFF, N KEMMLE		62	201776		
REAC	U O				
POLUNINA, G KOVBA		61	201624		
REAC	U O				
SAND, T IMOTO, S		60	200963		
REAC	U O				
UKA, R MINAMI, F		61	201623		
REAC	U O				
ANTH, J		62	201973		
THER	U O				
SCHICK, H ANTHROP		63	301579		
CRYS	U O 2				
WILLIS, B		63	301623		
REAC	U O 2				
ORBACH, H		62	301547		
THER	U O 2				
SCHICK, H ANTHROP		63	301579		
TRT	U O 2				
CHIKALLA, T		63	301203		
TRT	U O 2				
MUMPTON, F ROY, R		60	301308		
REAC	U O 2				
CORDFUNK, E		61	201785		
VAP	U O 2				
GERDANIAN, P DODE		62	201886		
BIB	U O 2				
REISWIG, R		61	601378		
BIB	U O 2				
WENSRICH, C		60	700972		
BIB	U O 2				
BELLE, V		57	601611		
BIB	U O 2				
SHAPIRO, Z		57	601612		
BIB	U O 2				
HAUSNER, H		59	601630		

CPH	U O 2			REAC	U O 2		
	KOENIG, N	58	601366		ANDERSON, J SAWYER	60	601172
CPH	U O 2			REAC	U O 2		
	CABBAGE, A WELCH	61	601443		HOEKSTRA, H	61	201177
CPH	U O 2			REAC	U O 2		
	POPOV, M GALCHENKO	58	601163		DAS, C SAHOO, B	61	201466
CPL	U O 2			REAC	U O 2		
	JONES, W M GORDON	52	400556		LYNDS, L	62	201682
CPL	U O 2			REV	U O 2		
	OSBORNE, D WESTRUM	53	600968		KAUFMANN, A	62	601429
CRYS	U O 2			REV	U O 2		
	HASHIGUCHI, R MATS	60	200856		SEDDON, J	60	601380
CRYS	U O 2			REV	U O 2		
	TUXWORTH, R	60	600849		SHAPIRO, E	57	601296
CRYS	U O 2			REV	U O 2		
	CHIOTTI, P	49	601416		BELLE, J	58	601202
CRYS	U O 2			REV	U O 2		
	VAN ARKEL, A	24	701056		TENNERY, J	59	601535
CRYS	U O 2			RHO	U O 2		
	CHIOTTI, P	52	601237		KOENIG, N	58	601366
CRYS	U O 2			S	U O 2		
	ROBINS, R WILKS, R	62	201821		ACKERMANN, R	56	601322
CTEX	U O 2			TCON	U O 2		
	LAMBERTSON, W	56	601323		ROSE, R	58	601392
CTEX	U O 2			TCON	U O 2		
	FUIKERSON, S	60	601361		DAYTON, R	58	601527
CTEX	U O 2			TCON	U O 2		
	KOENIG, N	58	601366		DAYTON, R	58	601526
CTEX	U O 2			TCON	U O 2		
	KEMPTER, C ELLIOTT	59	601150		DAYTON, R	58	601529
CTEX	U O 2			TCON	U O 2		
	HALDEN, F WOHLERS	59	201836		DAYTON, R	58	601557
DH	U O 2			TCON	U O 2		
	ACKERMANN, R	56	601322		DAYTON, R	58	601556
DH	U O 2			TCON	U O 2		
	ARONSON, S	61	201318		REISWIG, R	61	601378
DF	U O 2			TCON	U O 2		
	ACKERMANN, R THORN	58	601510		KOENIG, N	58	601366
ELCH	U O 2			TCON	U O 2		
	LAMBERTSON, W	56	601323		HEDGE, J	57	601294
KIN	U O 2			TCON	U O 2		
	ARONSON, S ROOF, R	57	601068		MAKIN, B	54	601286
KIN	U O 2			TCON	U O 2		
	KUHLMAN, C	48	201904		GILBREATH, J	55	601274
KIN	U O 2			TCON	U O 2		
	KUHLMAN, C	48	201115		FLINTA, J	58	601095
MISC	U O 2			TCON	U O 2		
	BUTLER, G HAUSNER	60	200915		BETHOUX, O THOMAS	61	201534
MPP	U O 2			TCON	U O 2		
	KOENIG, N	58	601366		BERG, K FLINTA, L	58	201533
MPP	U O 2			TCON	U O 2		
	PRIEST, H PRIEST	58	601147		SCOTT, R	58	601115
MSP	U O 2			TCON	U O 2		
	DEMAU, G BURNS, R	60	601163		POWERS, R	60	201184
PHAS	U O 2			TCON	U O 2		
	KOENIG, N	58	601366		BERG, K	58	601544
PHAS	U O 2			TCON	U O 2		
	LAMBERTSON, W	56	601323		ROSS, A	58	601493
PHAS	U O 2			TCON	U O 2		
	HERING, H PERIO, P	52	601236		TENNERY, J	59	601535
PHAS	U O 2			THER	U O 2		
	PERIO, P	53	601216		ACKERMANN, R	56	601273
PHAS	U O 2			THER	U O 2		
	BARD, R BOWERSOX	57	601060		ACKERMANN, R THORN	58	601087
PHAS	U O 2			THER	U O 2		
	NEWKIEK, H BATES	59	601165		ACKERMANN, R GILLE	58	601233
PHAS	U O 2			THER	U O 2		
	ROTHWELL, E	62	601476		ARONSON, S BELLE	58	601077
PHAS	U O 2			THER	U O 2		
	EVANS, P	61	201362		ACKERMANN, R GILLE	56	601045
PHAS	U O 2			THER	U O 2		
	COHEN, I SCHANER	62	201845		SMIRNOV, M	60	201191
REAC	U O 2			THER	U O 2		
	BARD, R BOWERSOX	57	601060		IVANOV, V KRUGLYKH	62	601604
REAC	U O 2			TRT	U O 2		
	ARONSON, S ROOF, R	57	601068		CHIOTTI, P	52	601237
REAC	U O 2			TRT	U O 2		
	BLACKBURN, P WEISS	58	601114		CHIOTTI, P	49	601416

TRT	U O 2			CRYS	U 30 8		
	WISNYI, L	57	601500		CHODURA, B MALY, J	58	601546
VAP	U O 2			CRYS	U 30 8		
	ACKERMANN, R	56	601322		GRONVOLD, F	48	601379
VAP	U O 2			CRYS	U 30 8		
	ACKERMANN, R	55	601273		ANDERSON, A	58	601078
VAP	U O 2			CRYS	U 30 8		
	ACKERMANN, R THORN	58	601510		WILSON, W	60	601183
VAP	U O 2			CPL	U 30 8		
	ANON	57	601514		WESTRUM, E GRONVOL	59	601133
VAP	U O 2			DH	U 30 8		
	IVANOV, V KRUGLYKH	62	601604		POPOV, M IVANOV, M	57	601086
TRT	U O 2			DHT	U 30 8		
	WISNYI, L PIJANOWS	57	601081		KHOMYAKOV, K SPITS	61	300729
TRT	U O 2			ERES	U 30 8		
	ANDERSON, J SAWYER	60	601172		BRIDGMAN, P	51	400533
TRT	U O 2			PHAS	U 30 8		
	NEWKIEK, H BATES	59	601165		PERIO, P	53	601216
ZKP	U O 2			PHAS	U 30 8		
	SMIRNOV, M	60	201191		HERING, H PERIO, P	52	601236
CPH	U O 3			REAC	U 30 8		
	POPOV, M GALCHENKO	58	601153		KHLEBNIKOV, G SIMA	61	201625
CPL	U O 3			REAC	U 30 8		
	JONES, W M GORDON	62	400555		VLASOV, V KOZLOV	62	201591
CRYS	U O 3			THER	U 30 8		
	CORNMAN, W	62	301030		WESTRUM, E	58	601553
CRYS	U O 3			CPL	U 40 9		
	DEWOLFF, P	61	601424		OSBORNE, D	56	601254
CRYS	U O 3			CRYS	U 40 9		
	CONNOLLY, D	59	601365		BELBEOCH, B PIEKAR	60	601426
CRYS	U O 3			REAC	U 40 9		
	WATT, E	55	601268		HOEKSTRA, H	61	201177
DF	U O 3			THER	U 40 9		
	ACKERMANN, A THORN	60	601174		OSBORNE, D	56	601254
KIN	U O 3			TRT	U 40 9		
	STREKALOVSKII, V A	61	201079		ZHU KOVSKII, E TKAC	63	301628
KIN	U O 3			CEMP	U OXIDES		
	KUHLMAN, C	48	201106		WILLARDSON, R MOOD	58	601104
KIN	U O 3			CRYS	U OXIDES		
	KUHLMAN, C	48	201904		MAKAROV, E	61	301114
MPP	U O 3			CRYS	U OXIDES		
	PRIEST, H PRIEST	58	601147		FRIED, S	56	601021
REAC	U O 3			DHD	U OXIDES		
	VLASOV, G ZHUKOVSK	62	301612		VLASOV, V LEBEDEV	61	201185
SPK	U O 3			KIN	U OXIDES		
	TSUBOI, M TERADA	62	201721		VLASOV, V LEBEDEV	61	201185
MSP	U O 3			KIN	U OXIDES		
	DEMAI, A G BURNS, R	60	601163		BESSONOV, A VASLOV	61	201468
REAC	U O 3			PHAS	U OXIDES		
	VLASOV, V SHALAGIN	61	201027		BUD' KOV, T TRESVY	59	201395
REAC	U O 3			THER	U OXIDES		
	STREKALOVSKII, V A	61	201079		BREWER, I BROMLEY	47	400581
REAC	U O 3			REAC	U OXIDES		
	MURAI, M EYRAUD, C	62	201692		MANDELBERG, C	61	201335
SPK	U O 3			BIB	U O SYST		
	BOROVSKI, I BARINO	50	400551		LANG, S	53	100195
TRT	U O 4			BIB	U O SYST		
	WISNYI, L PIJANOWS	57	601056		COMSTOCK, M	60	600623
REAC	U 20 5			CRYS	U O SYST		
	KHLEBNIKOV, G SIMA	61	201625		BOULLE, A JARY, R	49	400537
CRYS	U 30 5			CRYS	U O SYST		
	SIEGEL, S	55	601267		BAINZIGER, N WILSO	58	601142
CPL	U 30 7			DF	U O SYST		
	WESTRUM, E GRONVOL	62	300752		BLACKBURN, P	58	601113
DH	U 30 7			ERES	U O SYST		
	MUKAIBO, T NAITO	62	601609		BRABERS, M	58	601212
THER	U 30 7			MPP	U O SYST		
	MUKAIBO, T NAITO	62	601609		CLAZTON, J ARONSON	58	601122
CPH	U 30 8			PHAS	U O SYST		
	KHOMYAKOV, K SPITS	61	300729		GERDANIAN, P DODE	62	300355
CPH	U 30 8			PHAS	U O SYST		
	POPOV, M GALCHENKO	58	601153		GRONVOLD, F	55	601001
CPH	U 30 8			PHAS	U O SYST		
	ZAJIC, V	60	601170		HOEKSTRA, H SIEGEL	58	601209
CPH	U 30 8			PHAS	U O SYST		
	POWERS, H WELCH, F	61	601444		KATZ, J	51	400534
CPL	U 30 8			PHAS	U O SYST		
	WESTRUM, E	58	601553		HOEKSTRA, R SIEGEL	56	601022

PHAS	U O SYST			DH	U O CL SYST		
HOEKSTRA, H		55	601280	SHCHUKAREV, S VASI		58	200798
BIB	U O SYST			KIN	U Y O SYST		
MANDIL, I SCOTT, R		61	201303	FELTEN, E AITKEN		62	201690
ERES	U O SYST			CRYS	U RE2		
HAUFFE, K		41	601483	HATT, B		61	200929
DH	U O SYST			DH	U SI		
BURDESE, A		58	601560	GROSS, P HAYMAN, C		62	601621
KIN	U O SYST			DH	U SI2		
LEIBOWITZ, L		61	201314	GROSS, P HAYMAN, C		62	601621
PHAS	U O SYST			DH	U SI3		
AUKRUST, E FOERLAN		62	601606	GROSS, P HAYMAN, C		62	601621
PHAS	U O SYST			DH	U 3SI2		
MARKIN, T ROBERTS		62	601608	GROSS, P HAYMAN, C		62	601621
PHAS	U O SYST			PHAS	U TA C SYST		
WESTRUM, E GRONVOL		62	601613	RUDY, E BENESOVSKY		63	301333
PHAS	U O SYST			PHAS	U TH C SYST		
SCHANER, B		60	601686	BENESOVSKY, F RUDY		61	300542
PHAS	U O SYST			PHAS	U W C		
WILSON, W		61	601448	RUDY, E BENESOVSKY		62	201628
PHAS	U O SYST			REAC	U W O		
HOEKSTRA, H		58	601487	TRUNOV, V LOVBA, L		61	201486
PHAS	U O SYST			PHAS	U ZR SYST		
KIUKKOLA, K		62	601469	BENESOVSKY, E RUDY		61	100181
TCON	U O SYST			PHAS	U ZR SYST		
BRUBERS, M		58	601546	BOROVSKII, I MARCH		60	201014
TCON	U O SYST			PHAS	U ZR		
ROSS, A		58	601493	ZEGLER, S		62	201647
THER	U O SYST			PHAS	U ZR C SYST		
ACKERMANG, R THORN		62	601616	RUDY, E BENESOVSKY		63	301333
THER	U O SYST			PHAS	U ZR NB SYST		
MARKIN, T ROBERTS		62	601608	IVANOV, O GOMOZOV		61	201896
THER	U O SYST			PHAS	U ZR O SYST		
WESTRUM, E GRONVOL		62	601613	GEBHARDT, E ELSSNE		61	301049
THER	U O SYST						
KIUKKOLA, K		62	601469				
VAP	U O SYST						
ACKERMANN, R THORN		62	601616				
VAP	U O SYST						
WESTRUM, E GRONVOL		62	601613				
VAP	U O SYST						
CHAPMAN, A		63	202016				
PHAS	U O SYST						
PERIO, P		53	601283				
PHAS	U O SYST						
MILLER, C MERTEN		61	601407				
PHAS	U O SYST						
BARON, J		61	601433				
PHAS	U O SYST						
ROBERTS, L		61	601434				
PHAS	U O SYST						
BRIGHT, N		56	601288				
PHAS	U O SYST						
STEEB, S		60	200882				
PHAS	U O SYST						
BOULLE, A JARY, R		49	400537				
PHAS	U O SYST						
ALBERMAN, K ANDERS		49	400538				
PHAS	U O SYST						
STREKALOVSKIY, V B		61	400613				
PHAS	U O SYST						
BLACKBURN, P		58	601113				
PHAS	U O SYST						
PERIO, P		55	601033				
PHAS	U O SYST						
BAINZIGER, N WILSO		58	601142				
REV	U O SYST						
BAGLEY, K OLIVER		59	601141				
SPK	U O SYST						
GRONVOLD, F		55	601001				
THER	U O SYST						
HOEKSTRA, R SIEGEL		56	601022				
THER	U O SYST						
WAGNER, C		56	601026				
THER	U O SYST						
BREWER, L BROMLEY		58	601146				
VAP	U O SYST						
ALEXANDER, C		62	300633				

V

CPH	V			CPH	V	60	301488
JOHNSON, R				CPH	V	62	301488
GOLUTOIN, Y KOZLOV				CPL	V	63	301239
HENDRICKS, J RISER				MPP	V	62	301526
LINCOLN, R ASAI, G				VAP	V	63	301576
SAXER, R				THER	V	62	601677
KUBASCHEWSKI, O				MISC	V	62	301139
GAIDUKOV, G GAIDUK				BIB	V	60	700723
WOHLL, M				CEMP	V	49	601638
RICKERT, E BECKETT				CEMP	V	61	600853
BURGER, J TAYLOR				CPL	V	63	202082
KREBS, K				CPL	V	63	202136
SHIMIZU, M TAKAHAS				COPT	V	60	700930
GOLDSMITH, A HIRSC				CPH	V	60	601683
FIELDHOUSE, I LANG				KIN	V	62	601677
KUBASCHEWSKI, O				CPH	V	60	700930
GOLDSMITH, A HIRSC				CPH	V	60	200767
JOSHI, S MITRA, S				CPH	V	62	301083
GOLUTVIN, Y KOZLOV				CPL	V	62	601583
CLARK, C							

CPL	V			THEO	VAPORIZATION		
CLUSIUS, K FRANZOS		60	700987	SALTER, L		63	300986
CPL	V			THEO	VAPORIZATION		
JOSHI, S MITRA, S		60	200767	VERHAEGEN, G STAFF		62	301010
CPL	V			THEO	VAPORIZATION		
BIEGANSKI, Z STALI		61	700660	NEUMANN, K VOLKER		32	900212
CPL	V			THEO	VAPORIZATION		
BOORSE, H BERMAN		55	700887	ROSENBLATT, G		63	301562
CRYS	V			THEO	VAPORIZATION		
JAMES, W		61	201196	ACKERMANN, R THORN		62	301391
CTEX	V			THEO	VAPORIZATION		
JAMES, W		61	201196	FEUER, P		63	202031
CTEX	V			REV	VAPORIZATION		
FIELDHOUSE, I LANG		60	601583	FISHTINE, Q		63	202032
ERES	V			THEO	VAPORIZATION		
TAYLOR, M LLEWELL		62	201675	KOLLAR, G PROSZT		63	202075
ERES	V			THEO	VAPORIZATION		
GOLDSMITH, A HIRSC		60	700930	PUTILOV, K MELMICH		62	300602
H	V			THEO	VAPORIZATION		
GOLDSMITH, A HIRSC		60	700930	FIRSOVA, L		62	300697
MPP	V			THEO	VAPORIZATION		
RICKERT, E BECKETT		49	601638	REIMANN, C		62	300469
MPP	V			THER	V B		
BRADFORD, S		61	300368	MEERSON, G		60	300298
PMCH	V			CRYS	V 3B 2		
BOLEF, D		61	200936	KIEFFER, B BENESOV		58	600619
PHAS	V			DH	V BR3		
SEYBOLT, A		4P	601484	VASILKOVA, I		61	201222
PHAS	V			REAC	V BR3		
ZELIKMAN, A KISLYA		61	701037	SHCHUKAREV, S TOLM		62	201809
PHAS	V			CEMP	V C		
SAVITSKII, E BARON		62	300609	MATSKEVICH, T KAZA		62	300952
PHAS	V			CEMP	V C		
BRADFORD, S		61	300368	NOGUCHI, S SATE, T		60	300227
PHAS	V			CPH	V C		
KOMJATHY, S		61	201434	NEEL, D PEARS, C		61	300146
PHAS	V			DF	V C		
KOMJATHY, S READ		60	201394	ALEKSEEVA, V I		61	300201
REAC	V			DHD	V C		
DEUTSCH, N ERVIN		60	600123	BITTNER, H GORETZK		62	301132
REAC	V			MPP	V C		
BLOCK, F FERRANTE		61	201013	NORTON, J MOWRY, A		49	300157
REAC	V			PHAS	V C		
KORNILOV, I MATVEY		61	400588	NORTON, J		60	701001
REV	V			S	V C		
ZELIKMAN, A KISLYA		61	701037	KAUFMAN, L		62	300910
REV	V			SPK	V C		
SPERNER, X		61	300372	PARKINSON, W NICH		59	00612
REV	V			THER	V C		
KORNILOV, I MATVEE		62	201946	FUJISHIRO, S		62	611477
S	V			THER	V C		
CLUSIUS, K FRANZOS		60	700987	ANON		60	700992
SPK	V			THER	V C		
ROSENZWEIG, N PORT		60	700996	ANON		60	700904
SPK	V			VAP	V C		
MURAKAWA, K KAMEI		53	601218	ANON		60	700992
SPK	V			VAP	V C		
ROSENZWEIG, N PORT		60	700901	ANON		60	700904
SPK	V			VAP	V C		
BOLOTIN, G VOLOSHI		62	201830	FUJISHIRO, S		60	300463
TCON	V			VAP	V C		
FIELDHOUSE, I LANG		60	601583	ANON		60	600666
TCON	V			CEMP	V C		
GOLDSMITH, A HIRSC		60	700930	BITTNER, H GORETZK		62	202004
THEO	V			MPP	V C		
ROSENZWEIG, N PORT		60	700901	GIORGI, A SZELARZ		63	202039
THEO	V			REAC	V C		
ROSENZWEIG, N PORT		60	700996	SAMSONOV, G			301571
THER	V						

PHAS	V C SYST			REAC	V 20 5		
STORMS, E MCNEAL		62	300608	MATSOURA, R		61	201028
PHAS	V C SYST			REAC	V 20 5		
SAVOSTIANOVA, N		60	300204	DEDUIT, J		61	700611
ERES	V CR			DH	V 20 5		
TAYLOR, M LLEWELL		62	201675	KING, E KOEHLER		62	301500
PHAS	V C FE SYST			ERES	V 20 5		
BELIKOV, A SAVINSK		62	300863	BQROS, J		61	301192
PHAS	V MN			REAC	V 20 5		
WATERSTRAT, R		62	201584	HAGENMULLER, P LES		63	301467
PHAS	V MO SI SYST			VAP	V 20 5		
SAVITSKII, E BARON		62	201798	NEUGENAUER, J		63	301311
MPP	V N			ERES	V 20 5		
SAMSONOV, G VERKHO		62	300997	MANAKOV, P ESIN, O		62	202096
MPP	V N			CRYS	V 20 5		
SAMSONOV, G VERKHO		61	301573	BACHMANN, H		61	201154
S	V N			CRYS	V 30 5		
KAUFMAN, L		62	300910	ASBRINK, S FRIBERG		59	200825
ZKP	V N			SURF	V OXIDES		
KOROLEV, L MOROZOV		62	301272	LEPINSKIKH, B		60	201215
THER	V N			PHAS	V OXIDES		
KOROLEV, L MOROZOV		63	301273	ANDERSSON, S		59	201178
THEO	V N			CRYS	V OXIDES		
BAUGHAN, E		59	300866	MAGNELI, A ANDERSON		61	201566
CRYS	V N 2			PHAS	V O SYST		
HAHN, H		61	701046	WESTMAN, S		63	301621
PHAS	V N 2			THEO	V O SYST		
HAHN, H		61	701046	GELD, P TSKHAL, V		63	202036
DH	V NITRIDES			CPH	V O SYST		
SAMSONOV, G		60	700947	YAKOVLEVA, M KRASI		61	300351
CEMP	V NITRIDES			CRYS	V O SYST		
SAMSONOV, G		60	700947	ARIYA, S POPOV, Y		62	300599
REV	V NITRIDES			DF	V O SYST		
SAMSONOV, G		60	700947	MAH, A KELLEY, K		61	300407
CRYS	V O			DH	V O SYST		
MAGNELI, A		60	600617	MOROZOVA, M P EGER		60	300247
THER	V O			DH	V O SYST		
HOCH, M		61	301475	MAH, A KELLEY, K		61	300407
SPK	V O			KIN	V O SYST		
ORTENBERG, F		61	300821	CUBICCIOTTI, D		52	100194
SPK	V O			MPP	V O SYST		
NICHOLLS, R		62	300698	HOGDANOVA, N LOGIN		62	300640
SPK	V O			PHAS	V O SYST		
LAGERQVIST, A SELI		57	300166	KUBASCHEWSKI, O		62	601577
SPK	V O			PHAS	V O SYST		
NICHOLLS, R		62	601625	BURDESE, A BORLERA		60	200945
SPK	V O			PHAS	V O SYST		
BERG, R A SINANOGL		60	300177	NADOR, B		60	200938
REAC	V O			VAP	V O SYST		
MARGOTIN, P STUCKE		61	201574	SHCHUKAREV, S SEME		59	301353
SPK	V O			PHAS	V O SYST		
PRASAD, S		63	202120	KOSUGE, K TAKADALI		62	301276
QPK	V O			CRYS	V O SYST		
LAGERQVIST, A		57	301290	GELD, P TSKHAY, V		63	301225
CRYS	V O			PHAS	V O SYST		
POPOV, YU		62	301321	ANON		60	701015
SPK	V O			PHAS	V O SYST		
LAGERQVIST, A		57	600885	GELD, P V ALYAMOSK		61	300200
SPK	V O			PHAS	V O SYST		
KEENAN, P SCHROEDE		52	600911	WESTMAN, S NORDMAR		60	201329
SPK	V O			VAP	V O SYST		
TAWDE, N MURTHY, N		57	600913	ANON		60	701015
THER	V O 2			ZKP	V O SYST		
SCHICK, H ANTHROP		63	301580	ARIYA, S MOROZOVA		62	300600
CRYS	V O 2			REAC	V O C SYST		
HECKINGBOTTOM, R L		62	300704	GELD, P MATVEYENKOL		62	301224
MPP	V O 2			PHAS	V RE SYST		
DAY, J FREYMAN, M		49	400517	TYLKINA, M POVAROV		60	201291
PHAS	V O 2			DH	V SI SYST		
WESTMAN, S		61	700545	GOLUTVIN, Y		62	301229
SPK	V O 5			CPH	V SI SYST		
CONLON, D DOYLE, W		61	201325	GOLUTVIN, Y KOZLOV		62	300568
REAC	V 20 3			PHAS	V W SYST		
GELD, P MATVEENKO		62	201913	RUDY, E BENESOVSKY		62	300630
REAC	V 20 3			THER	V X		
MATSOURA, R		61	201028	SHCHUKAREV, S TOLM		62	201540
CRYS	V 20 5			THER	V CL O		
BACHMAN, H		60	200785	NAGARAJAN, G		62	201816

THER	V CL O SYST		
NAGARAJAN, G		62	201772
CPH	V 3SI		
PANKRATZ, L KELLEY		63	301319
REAC	V X SYST		
ARADI, A VITANYI		61	201862

W

REAC	W		
BROPHY, J KREIDER		63	202011
SPK	W		
CLAUS, H ULMER, K		63	202017
MPP	W		
KOPETSKIY, CH		62	301270
THER	W		
KRAFTMAKHER, YA		62	301280
BIB	W		
GOODWIN, T		56	601547
BIB	W		
WOHL, M		60	700723
BIB	W		
WENSCH, C		60	700972
BIB	W		
RICHERT, E BECKETT		49	700564
CEMP	W		
GUMENYUK, V LEBEDE		61	700553
COPT	W		
COFFMAN, J COULSON		61	701040
CPH	W		
HOCH, M		61	201167
CPH	W		
CHEKHOVSKOY, V SHU		62	300868
CPH	W		
JOHNSON, R		60	301488
CPH	W		
KIRILLIN, V SHEIND		62	300638
CPH	W		
KIRILLIN, V SHEIND		62	300687
CPH	W		
KIRILLIN, V SHEIND		62	300360
CPH	W		
KIRILLIN, V SHEIND		62	300531
CPH	W		
RUDKIN, R PARKER		60	600614
CPH	W		
JAEGER, F ROSENBOH		27	700506
CPH	W		
JAEGER, F ROSENBOH		30	700506
CPH	W		
FORSYTHE, W WORTH		25	700507
CPH	W		
ZWIKKER, C SCHMIDT		28	700516
CPH	W		
MAGNUS, A DANZ, H		26	700560
CPH	W		
BRONSON, H CHISHOL		33	700561
CPH	W		
MAGNUS, A HOLZMAN		29	700562
CPH	W		
HOCH, M JOHNSTON		61	700613
CPL	W		
CLARK, C		62	601563
CPL	W		
FEATHERSTON, F NEI		63	301444
CPL	W		
MYERS, A		60	700981
CPL	W		
LANGE, F		24	700563
CPL	W		
SHARAN, B		61	301070
CRYS	W		
COFFMAN, J COULSON		61	701040
CRYS	W		
UMANSKII, M ZUBENK		60	600859

CRYS	W		
ANDERSON, S		60	200845
CRYS	W		
KOMAR, A SHREDNIK		62	300896
CRYS	W		
GETTE, E FOOTE, F		35	700510
CRYS	W		
LU S CHANG, Y		41	700512
CRYS	W		
CHAULTON, M DAVIS		55	700513
CRYS	W		
MATYUSHENKO, N		62	301150
CTEX	W		
NOWOTNY, H LAUBE		61	600844
DF	W		
COFFMAN, J COULSON		61	701040
ERES	W		
BRIDGMAN, P		61	400533
ERES	W		
TYE, R		61	201117
ERES	W		
GUMENYUK, V LEBEDE		61	700553
KIN	W		
ONG, J		62	201536
KIN	W		
ARZHANYI, P VOLKOV		62	201975
KIN	W		
GULBRANSEN, E ANDR		62	201770
MISC	W		
HAMPEL, C		61	200889
MISC	W		
BASKIN, M TRETYAKO		62	201951
MPP	W		
ARGENT, B MILNE, G		60	201039
PHAS	W		
ZALABAK, C		61	701026
PHAS	W		
SHAFFER, P		61	700941
PHAS	W		
COFFMAN, J COULSON		61	701040
PHAS	W		
BRILLIANTOV, N STA		61	300807
PHAS	W		
HAWORTH, C		60	201017
PHAS	W		
OREHOTSKY, J STEIN		62	300519
PHAS	W		
CHAULTON, M DAVIS		55	700513
PHAS	W		
ROSENBERG, W		60	201396
PHAS	W		
FUNKE, V NOVIKOVA		62	201704
REAC	W		
KUBASCHEWSKI, O HO		60	201038
REAC	W		
BECKER, J BECKER		61	201091
REAC	W		
GULBRANSEN, E ANDR		59	600638
REAC	W		
DEUTSCH, N ERVIN		60	500123
REAC	W		
FRANTSEVICH, I LAV		59	200869
REAC	W		
KOMAR, A TALANIN		60	200843
REAC	W		
MITROFANOV, O		62	301097
REAC	W		
ZELIKMAN, A KREIN		62	201861
REV	W		
WOHL, M		60	701053
REV	W		
SMITHELLS, C		53	700509
REV	W		
RICHERT, E BECKETT		49	700564
REV	W		
SYRE, R		61	201579
SPK	W		
ALLEN, R GLASIER		60	200828

SPK	W			CRY5	W C		
LARRABEE, A		57	201223	BUTORINA, L		60	700986
SPK	W			CRY5	W C		
ROSENZWEIG, N PORT		60	700996	PARTHE, E SADAGOPA		62	300520
SPK	W			DF	W C		
ROSENZWEIG, N PORT		60	700901	COFFMAN, J COULSON		61	701040
SPK	W			DF	W C		
MOORE, C		58	601088	GLEISER, M CHIPMAN		62	300866
SPK	W			MPP	W C		
BODMER, A		54	600936	KOVALCHENKO, M SAM		62	300920
TCON	W			PHAS	W C		
TYE, R		61	201117	COFFMAN, J COULSON		61	701040
TCON	W			PHAS	W C		
GUMENYUK, V LEBEDE		61	700553	GOLDSCHMIDT, H BRA		63	301457
THEO	W			PHAS	W C		
ROSENZWEIG, N PORT		60	700996	NADLER, M KEMPTER		60	300301
THEO	W			PHAS	W C		
ROSENZWEIG, N PORT		60	700901	FORELIK, C YELYUTI		62	300884
T KER	W			REAC	W C		
GOODWIN, T		56	601547	SHVEIKIN, G		62	301588
THER	W			REV	W C		
RUDKIN, R PARKER		60	600614	LECIEJWICZ, J		61	201199
TRT	W			THER	W C		
ZALABAK, C		61	200988	SCHICK, H ANTHROP		63	301579
TRT	W			THER	W C		
OREHOTSKY, J STEIN		62	300519	COFFMAN, J COULSON		60	701006
TRT	W			VAP	W C		
TAYLOR, A RYDEN, H		62	301027	COFFMAN, J COULSON		61	701040
VAP	W			VAP	W C		
NELSON, L KUEBLER		63	301540	COFFMAN, J COULSON		60	701006
VAP	W			THER	W 2C		
CANO, G		62	301423	SCHICK, H ANTHROP		63	301579
VAP	W			BIB	W COMPOUNDS		
LANGMUIR, I		13	700504	GODFREY, L BELL, P		59	600607
VAP	W			THER	W C SYST		
COFFMAN, J COULSON		61	701040	CUNNINGHAM, G WARD		63	301208
VAP	W			PHAS	W C SYST		
ZWIKKER, C		25	700508	ORTON, G		61	300610
H	W B			PHAS	W C SYST		
MEZAKI, R TILLEUX		62	601617	SARA, R DOLLOFF, R		62	601622
S	W B			PHAS	W C SYST		
MEZAKI, R TILLEUX		62	601617	GOLDSCHMIDT, H BRA		62	601626
THER	W B			REAC	W C SYST		
LEITNAKER, J BOWMA		62	300553	SAMSONOV, G STRASH		62	300990
PHAS	W B 4			THER	W CL		
CHRETIEN, A HELGOR		61	201084	SHCHUKAREV, S NOVI		59	200800
H	W 2B			MPP	W C N SYST		
MEZAKI, R TILLEUX		62	601617	GERASIMOV, A KONEV		61	300511
S	W 2B			PHAS	W HF SYST		
MEZAKI, R TILLEUX		62	601617	GIESSEN, B RUMP, I		62	201433
H	W 2B 5			PHAS	W HF		
MEZAKI, R TILLEUX		62	601617	SELL, H KEITH, G		61	201860
S	W 2B 5			PHAS	W MO RE SYST		
MEZAKI, R TILLEUX		62	601617	TYLKINA, M POVAROV		60	201292
REAC	W BORIDES			CRY5	W N		
SAMSONOV, G		59	600120	KHITROVA, V PINSKE		59	201620
REAC	W B SYST			CRY5	W N		
SAMSONOV, G STRASH		62	300990	KHITROVA, V PINSKE		60	201619
REAC	W BR3			CEMP	W NITRIDES		
MCCARLEY, R BROWN		62	201856	SAMSONOV, G		60	700947
DH	W BROMIDES			CRY5	W NITRIDES		
SHCHUKAREV, S KOKO		60	201159	KHITROVA, V PIN			301110
CEMP	W C			DH	W NITRIDES		
ZUBENKO, Y SOKOLSK		62	201676	SAMSONOV, G		60	700947
COPT	W C			REV	W NITRIDES		
COFFMAN, J COULSON		61	701040	SAMSONOV, G		60	700947
THER	W C			EMF	W O		
ALKESEEV, V SHARTS		63	301168	GERASIMOV, Y VASIL		60	200925
VAP	W C			MSP	W O		
FESENKO, V BOLGAR		63	301216	DEMAUA, G BURNS, R		60	601163
CRY5	W C			VAP	W O		
GORELIK, C ELYUTIN		62	301230	GLEMSE, O HAESELE		62	201927
CPH	W C			REAC	W O		
NEEL, D PEARS, C		61	300146	ANDES, G HECKEL, R		62	201498
CRY5	W C			REAC	W O		
LECIEJWICZ, J		61	201199	AUSTIN, L		61	201367
CRY5	W C			SPK	W O		
COFFMAN, J COULSON		61	701040	VITTALACHAR, U KRI		64	600697

REAC	Y		
SIMMONS	C FUNSTON	61	700808
REAC	Y		
NOLTING, H	SIMMONS	60	700841
REAC	Y		
THOMPSON, A	HOTTON	26	700828
REV	Y		
LOVE, B		60	700735
S	Y		
KELLEY, K		60	700891
SPK	Y		
SCHWARZSCHILD, M		57	601047
SPK	Y		
ROSENZWEIG, N	PORT	60	700996
SPK	Y		
SHADMI, Y		61	700954
SPK	Y		
GARSTANG, R		52	100207
SPK	Y		
CATALAN, M	RICO, F	57	601206
SPe	Y		
MOORE, C		52	100201
SPK	Y		
MOORE, C		52	100200
SPK	Y		
BUSCOMBE, W	MERRIL	52	100199
REV	Y		
STRUAT, K	WEIK, H	60	601167
REV	Y		
VICKERY, R		60	601173
SPK	Y		
BOHM VITENSE, E		60	601169
SPK	Y		
DIETER, V	EHRENSTE	57	601100
SPK	Y		
MERRILL, P	GREENST	58	601097
SPK	Y		
TESKE, R		58	601043
SPK	Y		
SKINNER, H		55	700761
SPK	Y		
CATALAN, M	RICO, F	52	601250
SPK	Y		
CATALAN, M	RICO, F	52	700800
SPK	Y		
BOVEY, F		55	700825
THEO	Y		
ROSENZWEIG, N	PORT	60	700996
THER	Y		
SCHICK, H	ANTHROP	63	300994
THER	Y		
SPEEDING, F	FLYNN	54	700824
TRY	Y		
HABERMANN, C	DAANE	63	301466
VAP	Y		
BEAVIS, L		60	701016
VAP	Y		
KARELIN, V	NESMEYA	62	700701
VAP	Y		
MCKENZIE, D	JENKIN	60	700805
VAP	Y		
KARELIN, R	NESMEYA	62	300914
VAP	Y		
BAUGHAN, E		54	700809
VAP	Y		
ACKERMANN, R	RAUH	62	700840
VAP	Y		
ACKERMANN, J	RAUH	62	700909
THER	Y +		
VASILEV, V	ZOLOTA	59	700823
CEMP	Y B 2		
JOHNSON, R	DAANE	63	301489
CRYS	Y B 4		
BINDER, I		60	700830
PHAS	Y B 4		
BINDER, I		56	700816
CEMP	Y B 6		
BENOIT, R		55	700822

CPH	Y 20 3		
CURTIS, C		57	700835
CPL	Y 20 3		
GOLDSTEIN, H		58	601551
CPL	Y 20 3		
GOLDSTEIN, H NEILS		59	700836
CRYS	Y 20 3		
STARITZKY, E		56	601292
CRYS	Y 20 3		
FERT, A		62	301447
CRYS	Y 20 3		
CURTIS, C		57	700835
DH	Y 20 3		
MONTGOMERY, R HUBE		60	700833
DH	Y 20 3		
HUBER, E HEAD, E		57	700842
H	Y 20 3		
KELLEY, K		60	700891
MPP	Y 20 3		
CURTIS, C THARP, A		59	700804
MPP	Y 20 3		
CURTIS, C		57	700835
PHAS	Y 20 3		
FANG, F KUZNETSOV		62	301443
PHAS	Y 20 3		
TOROPOV, N GALAKHO		61	201965
PHAS	Y 20 3		
STARITZKY, E		56	601030
S	Y 20 3		
KELLEY, K		60	700891
SPK	Y 20 3		
UHLER, U AKERLIND		59	700844
SPK	Y 20 3		
WICKERSHEIM, K LEF		61	201301
THER	Y 20 3		
KUBASHEVSKI, O EVA		56	700829
VAP	Y 20 3		
WALSH, P WHITE, D		58	700806
VAP	Y 20 3		
WALSH, P GOLDSTEIN		60	700814
VAP	Y 20 3		
MOTT, W		18	700827
PHAS	Y RE		
LOVE, B		60	201699
PHAS	Y U O SYST		
CHASE, G		62	201826
CPL	YB		
LOUNASMAAO		63	301527
DH	YB		
SAVAGE, W HUDSON		59	601126
DH	YB		
HUBER, E		56	601291
DH	YB		
HUBER, E HEAD, E		56	601041
SPK	YB		
KREBS, K NELKOWSKI		56	601029
SPK	YB		
BURBRIDGE, E BURBR		55	601003
SPK	YB		
MERRILL, P GREENST		56	601007
SPK	YB		
BODMER, A		54	600936
SPK	YB		
BRIX, P		62	400566
VAP	YB		
ANON		56	601319
VAP	YB		
SAVAGE, W HUDSON		59	601126
CEMP	YB B 6		
SAMSONOV, G PADERN		59	300143
CRYS	YB B 6		
STEPANOVA, A ZHURA		58	601111
CTEX	YB B 6		
STEPANOVA, A ZHURA		58	601111
CRYS	YB N		
EICK, H BAENZIGER		56	601046
ERES	YB N		
DIDCHENKO, R GORTS		63	301435

PHAS	YB N		
EICK, H BAENZIGER		56	601046
REAC	YB N		
EICK, H BAENZIGER		56	601046
REAC	YB NITRIDES		
EICK, H		57	601053
CPH	YB20 3		
PANKRATZ, L KING		63	202114
CPL	YB20 3		
JUSTICE, B WESTRUM		63	300907
DH	YB20 3		
HUBER, E		56	601291
REAC	YB OXIDES		
EICK, H		57	601053
PHAS	YB TH		
GSCHNEIDER, K		62	201700

Z

ERES	ZN		
RENUCCI, L LANGERO		61	201517
REV	ZN		
GIUORD, J		62	201554
BIB	ZR		
ANON		61	701047
BIB	ZR		
FELDMAN, M		61	701045
BIB	ZR		
WIL JAMS, G BAKER		52	600904
CPH	ZR		
CARTER, W		61	601631
CPH	ZR		
FIELDHOUSE, I LANG		60	601583
CPL	ZR		
MYERS, A		60	700981
CPL	ZR		
BORELIOUS, G		60	601168
CPL	ZR		
KNEIP, G BETTERTON		61	201412
CRYS	ZR		
BYKOV, V KAZARNIKO		59	201649
CRYS	ZR		
LAWLEY, A		60	200801
CRYS	ZR		
FELDMAN, M		61	701045
PHAS	ZR		
RICHTER, H WINCIERZ		62	201766
THER	ZR		
KUBAS, HEWSKI, O		62	601577
CRYS	ZR		
FOUNFELKER, R SIET		62	701089
CTEX	ZR		
CARTER, W		61	601631
CTEX	ZR		
NOWOTNY, H LAUBE		61	600844
CTEX	ZR		
FIELDHOUSE, I LANG		60	601583
DH	ZR		
FEDOROV, G		60	600823
DHT	ZR		
HERTZRICKEN, S SLY		62	300708
ERES	ZR		
BERLINCO, RT, T		59	601655
ERES	ZR		
BRIDGMAN, P		51	400533
ERES	ZR		
POWELL, R H TYE, R		61	700653
MISC	ZR		
SPACEK, V		61	200888
MISC	ZR		
SPINK, D		61	200891
MPP	ZR		
SKINNER, G BECKETT		50	601225
CRYS	ZR		
JAMIESON, J		63	301253

CPL	ZR		
KNIEF, G BETTERTON		63	301264
MPP	ZR		
RILEY, W MCCLELLAN		62	301080
PHAS	ZR		
KORNILOV, I		60	200907
PHAS	ZR		
FELDMAN, M		61	701045
PHAS	ZR		
IANNIELLO, L		61	201146
PHAS	ZR		
WORNER, H		60	200991
PHAS	ZR		
BIBB, A BEARD, A		61	201344
PHAS	ZR		
BEREZHNOI, A KORDY		62	201553
PHAS	ZR		
NISHIHARA, M		60	201493
PHAS	ZR		
WYDER, W HOCH, M		62	201581
PHAS	ZR		
MANNAS, D SMITH, J		62	201786
PHAS	ZR		
SEMENCHENKOV, A		61	201894
REAC	ZR		
MIYAMOTO, O NAKASH		58	500118
REAC	ZR		
BAKER, W		61	201057
REAC	ZR		
ANDREEVA, V ALEKSE		62	201814
REV	ZR		
SPERNER, F		61	300371
REV	ZR		
OSTBERG, G		61	201364
SPK	ZR		
RUBESKA, I		62	500119
SPK	ZR		
ROSENZWEIG, N PORT		60	700996
SPK	ZR		
SHADMI, Y		61	700954
SPK	ZR		
SWEENEY, W SEAL, R		61	201112
FPK	ZR		
SUWA, S		62	400675
SPK	ZR		
NORRIS, J		60	601194
SPK	ZR		
SHAW, C		55	600908
SURF	ZR		
BLITON, J RECHTER		63	301133
TCON	ZR		
TOIRELIKOV, V KOM		61	301101
TCMN	ZR		
FIELDHOUSE, I LANG		60	601583
TCON	ZR		
LOWRIE, R		61	700943
TCON	ZR		
POWELL, R H TYE, R		61	700653
THEO	ZR		
ROSENZWEIG, N PORT		60	700996
THER	ZR		
SCHICK, H ANTHROP		63	300994
THER	ZR		
FEDEROV, G SMIRNOV		61	601659
THER	ZR		
CARTER, W		61	601631
THER	ZR		
CARTER, W		62	300749
TRT	ZR		
JAYARAMAN, A KLEME		63	301482
TRT	ZR		
WILLIAMS, D JACKSO		62	301016
VAP	ZR		
TOIRELNIKOV, V KOM		61	301101
VAP	ZR		
YEMELYANOV, V		62	301626
VAP	ZR		
FEDEROV, G SMIRNOV		62	601620

CPH	ZR		
DOUGLAS, T		63	202029
MPP	ZR		
KAREV, V KLYUCHARE		63	202064
TRT	ZR		
ULY, J LAM, D IAN		61	202149
ZKP	ZR		
SMIRNOV, M KOMAROV		60	201066
CRYS	ZR B 2		
RUDY, E		61	201266
DF	ZR B 2		
WARD, J ALEXANDER		61	701066
DH	ZR B 2		
LOWRIE, R GRIST, R		61	300412
CRYS	ZR B 2		
GORELIK, C ELYUTIN		62	301230
VAP	ZR B 2		
KIBLER, G LYON, T		63	301269
THER	ZR B 2		
LITTLE, A		62	301626
DH	ZR B 2		
EPELBAUM, V A STAR		66	300194
H	ZR B 2		
MEZAKI, R TILLEUX		62	601617
MPP	ZR B 2		
SHCHERBAKOV, V VEY		60	300984
PHAS	ZR B 2		
FORELIK, C YELYUTI		62	300864
PHAS	ZR B 2		
MARTIN, R SEAGLE		61	300308
PHAS	ZR B 2		
FUNKE, V IUDKOVSKI		63	301138
S	ZR B 2		
MEZAKI, R TILLEUX		62	601617
SPK	ZR B 2		
LOWRIE, R		62	601696
THER	ZR B 2		
MEERSON, G		60	300298
THER	ZR B 2		
BOLGAR, A		61	700938
THER	ZR B 2		
LEITNAKER, J BOWMA		62	300392
TRT	ZR B 2		
MARTIN, R SEAGLE		61	300308
VAP	ZR B 2		
BOLGAR, A		61	700938
VAP	ZR B 2		
LEITNAKER, J BOWMA		62	300392
VAP	ZR B 2		
KIBLER, G LYON, T		61	300409
MPP	ZR B 2		
MALYUCHKOV, O POVI		62	202096
MPP	ZR B 2		
SHAFFER, P		62	202133
MPP	ZR B 2		
TYRRELL, M HOUCK		63	202148
VAP	ZR B 2		
LOWRIE, R		62	701081
VAP	ZR B 2		
LOWRIE, R SCHOMCHE		62	300940
VAP	ZR B 2		
SCHICK, H ANTHROP		63	300994
VAP	ZR B 2		
ANON		62	601697
VAP	ZR B 2		
LOWRIE, R		62	601696
YAP	ZR B 2		
LOWRIE, R GRIST, R		61	300412
PHAS	ZR B SYST		
ANON		60	701016
VAP	ZR B SYST		
ANON		60	701016
PHAS	ZR B C SYST		
NOWOTNY, H		61	201147
PHAS	ZR B C SYST		
NOWOTNY, H RUDY, E		60	201799
PHAS	ZR B CR SYST		
KOVALCHENKO, M SAM		60	300216

PHAS	ZR B2 MO SYST		
KOVALCHENKO, M S		61	300193
PHAS	ZR B2 MO SYST		
KOVALCHENKO, M SAM		60	300216
PHAS	ZR B N SYST		
NOWOTNY, H RUDY, E		60	201799
PHAS	ZR B N SYST		
RUDY, E BENESOVSKY		61	300486
CEMP	ZR BORIDES		
SAMSONOV, G KISLYY		61	900200
EMF	ZR BORIDES		
BECK, W		61	300477
REAC	ZR BORIDES		
SAMSONOV, G		59	600120
DH	ZR BR4		
TURNBULL, A		61	300259
CEMP	ZR C		
HODDAD, R GOLDWATE		49	300159
CEMP	ZR C		
HOPKINS, B ROSS, K		62	300515
REAC	ZR C		
BARTLETT, R WADSWO		63	301183
VAP	ZR C		
FESENKO, V BOLGAR		63	301216
CEMP	ZR C		
INGOLD, J		63	301251
CTEX	ZR C		
KRIKORIAN, WALLA		63	301285
DH	ZR C		
MAH, A BOYLE, B		55	301297
CEMP	ZR C		
BONDARENKO, B ERMA		62	301409
COPT	ZR C		
COFFMAN, J COULSON		61	701040
COPT	ZR C		
HODDAD, R E GOLDWA		49	300159
CPH	ZR C		
FINCH, R		61	700547
CPL	ZR C		
FINCH, R		61	700547
CRYS	ZR C		
VAN ARKEL, A		24	701056
CRYS	ZR C		
COFFMAN, J COULSON		61	701040
DF	ZR C		
VIDALE, G		61	301610
REAC	ZR C		
SAMSONOV, G			301571
THER	ZR C		
LITTLE, A		62	301526
TRT	ZR C		
SHAFFER, P		63	202132
CEMP	ZR C		
BITTNER, H GORETZK		62	202004
MPP	ZR C		
DERGUNOVA, V KOLON		63	202026
TRT	ZR C		
GROSSMAN, L		63	202044
CRYS	ZR C		
BENESOVSKY, F RUDY		60	700974
DF	ZR C		
COFFMAN, J COULSON		61	701040
DHD	ZR C		
BITTNER, H GORETZK		62	301132
ERES	ZR C		
FINCH, R		61	700547
MPP	ZR C		
NORTON, J MOWRY, A		49	300157
PHAS	ZR C		
SHAFFER, P		61	701057
PHAS	ZR C		
NORTON, J		60	701001
PKAS	ZR C		
SHAFFER, P		61	700941
PHAS	ZR C		
BENESOVSKY, F RUDY		60	700974
PHAS	ZR C		
COFFMAN, J COULSON		61	701040

S	ZR C		
KAUFMAN, L		62	300910
SPK	ZR C		
COFFMAN, J KIBLER		60	700993
SURF	ZR C		
HODDAD, R E GOLDWA		49	300159
TCON	ZR C		
TAYLOR, R		62	300694
THER	ZR C		
COFFMAN, J COULSON		60	701006
THER	ZR C		
COFFMAN, J KIBLER		60	700993
THER	ZR C		
BOLGAR, A		61	700938
THER	ZR C		
ANON		60	700992
THER	ZR C		
POLLOCK, B		61	600674
THER	ZR C		
ANON		62	601597
THER	ZR C		
ANON		60	700904
VAP	ZR C		
VIDALE, G		61	301611
VAP	ZR C		
SCHICK, H ANTHROP		63	300994
VAP	ZR C		
ANON		60	700904
VAP	ZR C		
ANON		60	700992
VAP	ZR C		
BOLGAR, A		61	700938
VAP	ZR C		
COFFMAN, J COULSON		60	701006
VAP	ZR C		
COFFMAN, J KIBLER		60	700993
VAP	ZR C		
COFFMAN, J COULSON		61	701040
VAP	ZR C		
POLLOCK, B		61	600674
VAP	ZR C		
COFFMAN, J COULSON		61	300293
VAP	ZR C		
ANON		60	600666
THER	ZR C SYST		
CUNNINGHAM, G WARD		63	301208
PHAS	ZR C SYST		
BENESOVSKY, F RUDY		60	600648
PHAS	ZR C SYST		
SARA, R DOLLOFF, R		62	301057
REAC	ZR C SYST		
PORTNOI, K LEVINSK		61	300216
PHAS	ZR C SYST		
SARA, R DOLLOFF, R		62	601622
VAP	ZR C SYST		
POLLOCK, B D		61	700536
PHAS	ZR CA O SYST		
GODINA, N KELER, E		61	201336
SPK	ZR CL4		
BUCHLER, A BERKOWI		61	300183
VAP	ZR CL4		
EVSTYUKHIN, A BARI		60	300882
THER	ZR CL SYST		
RUZINOV, L BELOV			301566
PHAS	ZR CO		
BAILEY, D SMITH, J		61	201546
PHAS	ZR CO O SYST		
NEVITT, M DOWNEY		61	201267
MPP	ZR CR B SYST		
MEYERSON, G		59	301115
VAP	ZR COMPOUNDS		
ANON		61	300239
REV	ZR COMPOUNDS		
BUDNIKOV, P CHEREP		63	301419
MPP	ZR COMPOUNDS		
STRELETS, V PITAK		62	300624
CPH	ZR F 4		
MCDONALD, R SINKE,		62	300662

DM	ZR F 4			REAC	ZR O		
GREENBERG, E	SETTL	61	300199	SENSE		62	201588
DM	ZR F 4			SPK	ZR O		
SMITH, D	MILLER, W	62	201542	MURTHY, N		62	601623
DHT	ZR F 4			SPK	ZR O		
MCDONALD, R	SINKE	62	300862	ROSEN, B		62	301560
SPK	ZR F 4			SPK	ZR O		
BUCHLER, A	BERKOWI	61	300183	ORTENBERG, F		61	300821
SPK	ZR HALIDES			SPK	ZR O		
BUCHLER, A		60	201465	KIESS, C		48	600685
THER	ZR HALIDES			SPK	ZR O		
LUNGU, S		62	300738	AFAP, M		50	600914
PHAS	ZR HF SI SYST			THEO	ZR O		
SCHOB, O	NOWOTNY	61	201547	FLODMARK, S		61	301033
PHAS	ZR HF X			THER	ZR O		
NISELSON, L		62	201551	SCHICK, H	ANTHROP	63	301579
DM	ZR 1 4			THER	ZR O		
TURNBULL, A		61	300259	ACKERMANN, R	THORN	58	601087
THER	ZR 1 4			THER	ZR O		
ALEKSANDROVSKAYA, A		62	201610	BEREZHOI, A		62	201541
PHAS	ZR MG O SYST			VAP	ZR O		
GODINA, N	KELER, E	61	201338	ACKERMANN, R	THORN	58	601510
VAP	ZR N			CPH	ZR O 2		
FESENKO, V	BOLGAR	63	301216	ROBIJN, P		63	301558
CRYS	ZR N			CPH	ZR O 2		
VAN ARKEL, A		24	701056	VICTOR, A	DOUGLAS	60	700949
MPP	ZR N			CRYS	ZR O 2		
SAMSONOV, G	VERKHO	61	301573	TEUFER, G		62	301604
VAP	ZR N			ERES	ZR O 2		
AKISHIN, P	KHODEEV	62	300592	COCCO, A	BARBARIOL	62	301430
CEMP	ZR N			ERES	ZR O 2		
SAMSONOV, G	FOMENK	63	202128	DIXON, J	LAGRANGE	63	301436
THEO	ZR N			MPP	ZR O 2		
BAUGHAN, E		59	300866	POLUBOYARINOV, D	G	62	301552
S	ZR N			CPH	ZR O 2		
KAUFMAN, L		62	300910	VICTOR, A	DOUGLAS	60	202153
VAP	ZR N			TRT	ZR O 2		
KIBLER, G	LYON, T	61	601579	VISHNEVSKII, I		62	202154
VAP	ZR N			TRT	ZR O 2		
KIBLER, G	LYON, T	61	601575	WOLTEN, G		63	202161
VAP	ZR N			PHAS	ZR O 2		
KIBLER, G	LYON, T	62	300427	FANG, F	KUZNETSOV	62	301443
CRYS	ZR N			PHAS	ZR O 2		
LOWRIE, R		60	701014	HINZ, I	DIETZEL, A	62	301472
MPP	ZR N			PHAS	ZR O 2		
SAMSONOV, G	VERKHO	62	300997	PEREZ Y JORBA, M		62	301491
DF	ZR N			PHAS	ZR O 2		
SMAGINA, Y	KUTSEV	59	300345	KELER, E	ANDREEVA	63	301496
CEMP	ZR NITRIDES			PHAS	ZR O 2		
SAMSONOV, G		60	700947	LEFEVRE, J		63	301519
DM	ZR NITRIDES			THER	ZR O 2		
SAMSONOV, G		60	700947	SCHICK, H	ANTHROP	63	301580
REV	ZR NITRIDES			TRT	ZR O 2		
SAMSONOV, G		60	700947	WEBER, B		62	301616
CRYS	ZR N SYST			TRT	ZR O 2		
GROZIER, J		61	701018	BUCKLEY, J		62	301418
KIN	ZR NB			TRT	ZR O 2		
COX, B	CHADD, P	62	201963	VAHLIDIEK, F	ROBINS	62	301606
PHAS	ZR NB SYST			TRT	ZR O 2		
LUNDEN, U	COX, R	61	300240	HINZ, I	DIETZEL, A	62	301473
PHAS	ZR NB SYST			TRT	ZR O 2		
LUNDIN, C		59	201119	BAUN, W		63	201999
PHAS	ZR NI O SYST			PHAS	ZR O 2		
NEVITT, M	DOWNEY	61	201267	CARROLL, D		63	202014
SPK	ZR O			PHAS	ZR O 2		
DEUTSCH, A							

CPL	ZR O 2		
VICTOR, A DOUGLAS,		60	700949
CRYB	ZR O 2		
ADAM, J ROGERS, M		59	300852
CRYB	ZR O 2		
COCCO, A SCHROMEK		61	201211
CRYB	ZR O 2		
VAN ARKEL, A		24	701056
CRYB	ZR O 2		
KOMISSAROVA, L SIM		60	200819
CRYB	ZR O 2		
STOCKER, J		61	201102
CRYB	ZR O 2		
BELOV, N		60	600676
CRYB	ZR O 2		
KELLER, E K ANDREE		61	300222
CTEX	ZR O 2		
GRAIN, C CAMPBELL		61	601471
H	ZR O 2		
VICTOR, A DOUGLAS		60	700949
MPP	ZR O 2		
PIROGOV, A		62	300625
MPP	ZR O 2		
YAVORSKY, P		62	201783
PHAS	ZR O 2		
GRAIN, C CAMPBELL		61	601471
PHAS	ZR O 2		
COLLONGUES R		61	201212
PHAS	ZR O 2		
COCCO, A		59	201168
PHAS	ZR O 2		
COCCO, A VIRDIS, P		61	201316
PHAS	ZR O 2		
WHITNEY, E		62	301017
PHAS	ZR O 2		
DELIMARSKY, Y BUDE		61	300880
PHAS	ZR O 2		
EVANS, P		61	201362
PHAS	ZR O 2		
EVANS, P WILDSMITH		61	600768
PHAS	ZR O 2		
VAHLIDIEK, F LYNCH		60	600870
PHAS	ZR O 2		
LYNCH, C VAHLIDIEK		61	700520
PHAS	ZR O 2		
SMITH, D CLEIN, C		62	201672
PHAS	ZR O 2		
COHEN, I SCHANER		62	201845
REAC	ZR O 2		
ARONSON, S		61	200998
REAC	ZR O 2		
MCTAGGART, F		61	300338
REAC	ZR O 2		
RUFF, O EBERT, F		29	900120
TCON	ZR O 2		
ADAMS, M		64	600961
THER	ZR O 2		
ACKERMANN, R THORN		58	601087
THER	ZR O 2		
MCCLAINE, L		60	300278
TRT	ZR O 2		
VAHLIDIEK, F LYNCH		60	600870
TRT	ZR O 2		
EVANS, P WILDSMITH		61	600768
VAP	ZR O 2		
NAKATA, M MCKISSON		61	300313
ZKP	ZR O 2		
ARONSON, S		61	200998
CRYB	ZR OXIDES		
MAGNELI, A ANDERSON		61	201656
THER	ZR OXIDES		
ORTNER, N ANDERSON		59	701066
VAP	ZR OXIDES		
ORTNER, N ANDERSON		59	701066
CRYB	ZR O SYST		
LICHTER, B		60	200774
THEO	ZR O SYST		
FLODMARK, S ROOS		63	301219

CRYB	ZR O SYST		
LICHTER, B		60	600670
ERES	ZR O SYST		
WASILEWSKI, R		62	301075
ERES	ZR O SYST		
GEBHART, E SAGHEZZ		61	300330
KIN	ZR O SYST		
KUBASCHEWSKI, O		62	601577
PHAS	ZR O SYST		
KUBASCHEWSKI, O		62	601577
MPP	ZR O SYST		
DEBUIGNE, J LEHR		63	202025
PHAS	ZR O SYST		
BURDESE, A BORLERA		60	200945
PHAS	ZR O SYST		
HOLMBERG, B DAGERH		61	300326
THER	ZR O SYST		
VEINBACHS, A KOMAR		62	601611
PHAS	ZR O CA SYST		
SHKHAREVSKII, B		61	201707
THER	ZR O CL SYST		
KOMISSAROVA, L PLY		60	200811
MPP	ZR O F SYST		
BU SLAYEV, Y GORBUN		62	300830
PHAS	ZR PT SYST		
KENDALL, E HAYS, C		61	201095
PHAS	ZR SI B SYST		
PARTHE, E NORTON		60	201404
PHAS	ZR SI O SYST		
KELER, E ANDREEVA		62	201888
PHAS	ZR SI O SYST		
COCCO, A SCHROMEK		60	201188
PHAS	ZR TH SYST		
EVANS, D		61	201254
PHAS	ZR TI NB SYST		
MIKHEEV, V BELOUSO		61	300834
PHAS	ZR TI O SYST		
COCCO, A SCHROMEK		60	201188
PHAS	ZR U C SYST		
BENESOVSKY, F RUDY		61	301406
PHAS	ZR U O SYST		
ARONSON, S CLAYTON		61	300258
CEMP	ZR U O SYST		
JOHANSEN, H CLEARY		62	201882
PHAS	ZR U O SYST		
VORONOV, N VOITEKH		61	201920
THER	ZR U O SYST		
ARONSON, S CLAYTON		61	300258
REAC	ZR WB SYST		
HELGORSKY, J		61	201887
THER	Z' X 4		
NAGARAJAN, G		62	201774